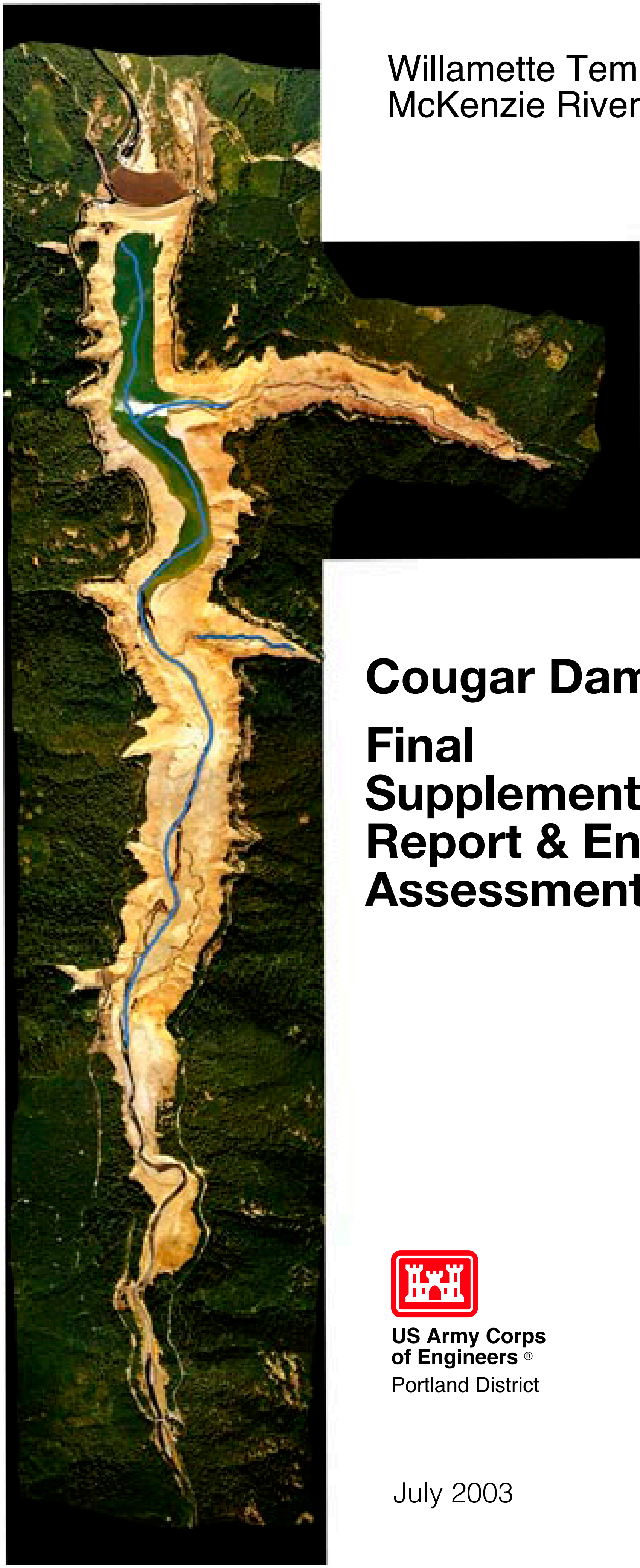

Willamette Temperature Control
McKenzie River Sub-Basin, Oregon

Cougar Dam and Reservoir

Final
Supplemental Information Report & Environmental Assessment Amendment

US Army Corps of Engineers ®
Portland District

July 2003

Cover photo: Aerial photograph of Cougar Reservoir with residual pool at 1,400 foot elevation. Fall 2002. Blue “river” is South Fork McKenzie channel location, pre-dam.

FINAL
SUPPLEMENTAL INFORMATION REPORT
WILLAMETTE TEMPERATURE CONTROL
MCKENZIE RIVER SUB-BASIN, OREGON
COUGAR DAM AND RESERVOIR

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ENVIRONMENTAL ASSESSMENT AMENDMENT

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FINAL
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WILLAMETTE TEMPERATURE CONTROL
MCKENZIE RIVER SUB-BASIN, OREGON
COUGAR DAM AND RESERVOIR

1.0 INTRODUCTION

Corps regulations for implementing NEPA, ER200-2-2,13(d), provides for publishing additional supplemental information documents on long-term or complex Environmental Impact Statements (EISs) to keep the public informed.

During the first year of project construction for Cougar Intake Tower Modification, drawdown of Cougar Reservoir resulted in unexpected turbidity below the dam in the South Fork McKenzie and McKenzie Rivers during Spring trout fly-fishing season. It was decided to prepare a supplemental information report (SIR) to address this turbidity and to investigate whether the turbidity had caused significant impacts to the river environment. Alternate methods of operating Cougar Reservoir during the remaining 2 years of construction also are being investigated. An amendment to the 1999 Environmental Assessment (EA) which supplemented the 1995 EIS, has also been prepared to address the turbidity, other new information, and the change in operation, based on data and analysis in this SIR.

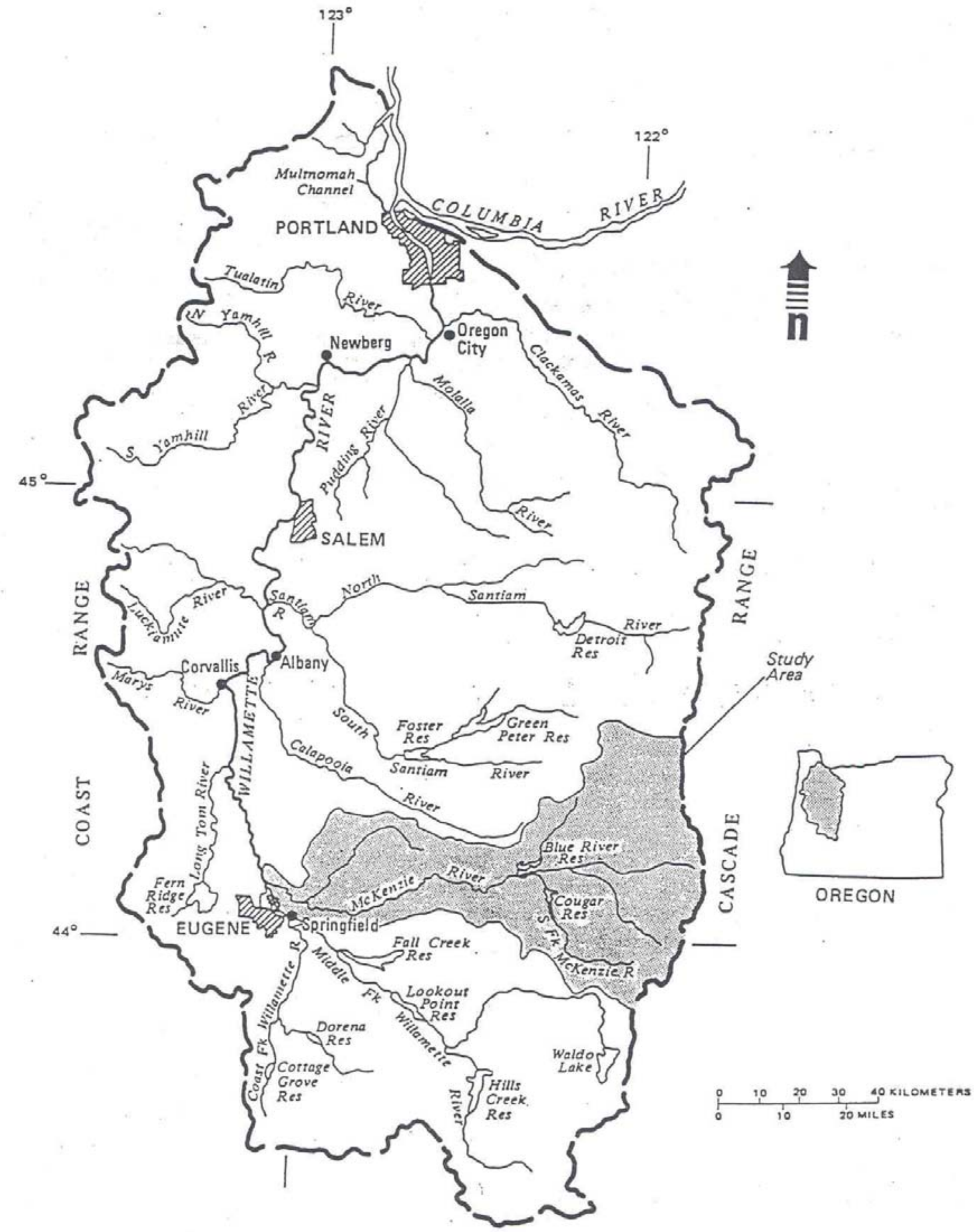
2.0 BACKGROUND

Cougar Project is an existing Federal reservoir project located in the watershed of the McKenzie River of western Oregon. (Figure 1) The McKenzie River originates in the upper elevations of the Cascade Mountains, flowing in a generally westerly direction to enter the Willamette River at River Mile (RM) 170.8 near Eugene. The Cougar Project provides flood control, recreation and power generation, and supplemental downstream flows for irrigation, navigation, fisheries, and pollution abatement.

A final Feasibility Report and Environmental Impact Statement (EIS) for Willamette Temperature Control was filed with the Environmental Protection Agency (EPA) in April 1995. The preferred alternative as described in the Record of Decision (ROD) signed January 9, 1997, was to construct intake structure modifications at both Blue River Lake and Cougar Lake. Construction at Cougar Lake was to begin in 1998, followed by Blue River Lake in 2002.

Following the ROD, design elements at Cougar Lake were further refined in Feature Design Memorandum (FDM) No. 21, published in July 1998. This refinement resulted in changes from the project description in the Feasibility Report. An environmental assessment (EA) and Finding of No Significant Impact (FONSI), signed in 1999, addressed changes in the proposed action at Cougar Lake since preparation of the final Feasibility Report/EIS.

Figure 1 -- *Willamette Basin Location Map*



2.1 Project Authorization. The Willamette River Temperature Control Project was authorized by the Water Resources Development Act (WRDA) of 1996 at a total Federal cost of $38,000,000. The authorization was based on the Feasibility Report dated April 1995. The authorization includes temperature control facilities at Cougar and Blue River projects, Oregon. In August of 1999, WRDA 1999 reauthorized the project at the cost presented in the 1998 FDM. Specific language was included related to cost growth of the project.

2.2 Construction. Construction of the Cougar portion of WTC began in August, 2001. The first phase involved strengthening and re-opening the diversion tunnel. The tunnel was reopened February 23, 2002, and drawdown of the reservoir began April 1. Reopening of the tunnel had been forecast for December 5, 2001 so that drawdown would begin February 1 and be completed to pool elevation 1,375 feet by April 1. Construction delays resulted in a later start than predicted. Phase 2 of the construction, modifications to the intake tower, began March 1, 2002.

2.3 Changes Since the Draft SIR. Since the draft SIR and Environmental Assessment amendment were released for public review on January 30, 2003, two relevant events occurred. One was a storm event in late January, following several other winter storm events. Storms occurred in late December 2002 which raised the reservoir elevation to 1,411 feet on December 31, 2002 and 1,413 feet on January 5, 2003. Turbidity on December 31 reached 202 NTUs. Turbidity levels rose again and reached 117 and 113 NTUs on January 3 and 5, 2003, respectively. Concurrent with the January 30 storm was a failure of the Rush Creek diversion outlet pipe. Following the initial elevated turbidity resulting from the failure, the pool was raised to 1,450 to cover the eroding slope below Rush Creek outlet. The slope failure caused an immediate spike in the turbidity downstream of the reservoir of 1,030 NTUs on January 30, 2003. The turbidity level dropped to 450 NTUs within 1 day and fell to 83 NTUs by February 3, 2003. While the slope failure caused an immediate spike, channel downcutting and migration by the South Fork McKenzie from January 30 to 31, 2003, resuspended a large amount of sediment contributing to the high turbidity observed downstream. (O'Brien, et al. 2003)

Once the situation stablized, turbidity returned to 2 NTUs by March 3, with occasional short-term increases due to rain or slope slump elsewhere in the reservoir. Based on surveys of the failed slope, the failure area is confined to overburden and has not impacted the toe of the dam. The Corps will continue to operate at 1,450 feet and monitor the slope to assess if any repairs are required. At this point, no repair action is planned.

Holding the reservoir at 1,400 feet during the winter did help regulate the turbidity until the January 30 storm when the Rush Creek outlet failed. Incoming turbidity in the South Fork during this January storm was about 78 NTUs. With the Rush Creek outlet failure, turbidity briefly (a one-half hour reading) exceeded 1,000 NTUs below the dam, and reached 100 NTUs on the mainstem McKenzie at Vida for a similar time period. As noted above, this cleared by early March. Turbidity during the March-April fly fishing season was, for the most part, near normal. In the March to May time period, incoming turbidity ranged from 30 to 0 NTUs; turbidity below the dam varied mostly between 25 and 2 NTUs, with one spike of 55 NTUs. Turbidity at Vida stayed between 15 and 1 NTUs with one spike of about 50 NTUs corresponding with the spike below the dam. Thus, managing the reservoir at elevation 1,450 during this period kept turbidity in the mainstem McKenzie within successful fishable limits. And, although the river was high, good insect hatches were reported (The Register-Guard, April 3, 2003). In addition, the coffer dam was not breached, and construction continued all winter and spring seasons, keeping the project on schedule.

3.0 ENVIRONMENTAL COMPLIANCE TO DATE

3.1 National Environmental Policy Act Analysis. A draft Feasibility Report/Environmental Impact Statement (FR/EIS) on the Willamette River Temperature Control, McKenzie River Sub-Basin, was released for public review in December 1994. Two public hearings were held in 1995. The final FR/EIS was released in April 1995. The FR/EIS covered temperature control proposals for Cougar Reservoir and Blue River Reservoir. The Corps proceeded to develop temperature control for Cougar Reservoir, preparing a Design Memorandum (DM 21) in 1998. Changes from the FR/EIS were addressed in a draft Environmental Assessment, released for public review in July 1999, and a Finding of No Significant Impact was signed 30 November 1999. A draft SIR and EA amendment was prepared and released for review on January 30, 2003. Section 404 evaluations under the Clean Water Act were prepared for both EIS and EA. State water quality certification was not requested since the project is exempt under Section 404(r) of the Clean Water Act, which provides a mechanism where Congress permits discharges of dredge or fill material through specific Congressional authorization of a project.

3.2. Clean Water Act Analysis. The Oregon Department of Environmental Quality reviewed both the 1995 EIS and the 1999 EA/Section 404 Evaluations. ODEQ's comments in 1999 were that the potential of the project to produce long-term, identifiable benefits to the fisheries resource through temperature modification appeared to outweigh any short-term effects of turbidity. Should turbidity during construction be visible in the McKenzie River, the reason must be determined and BMPs implemented to solve the problem and minimize the impacts. A log of storm events and river conditions should be maintained and problem events reported to ODEQ. These requirements have been followed by the Corps.

Turbidity refers to water clarity. It is measured in Nephelometric Turbidity Units (NTUs), which indicate how light passes through (or reflects on) suspended sediment in the water column. State standards for turbidity (OAR 340-041-0445(2)(c)) are no more than a 10 percent cumulative increase in natural stream turbidities as measured relative to a control point immediately upstream of the turbidity causing disturbance. However, limited duration activities necessary to accommodate essential dredging, construction or other legitimate activities may be authorized provided all practicable turbidity control techniques have been applied and permit or certification authorized under terms of Section 401 or 404 of the Clean Water Act.

3.3 Biological Assessment/Biological Opinion . A biological assessment (BA) for the Willamette Temperature Control project (Cougar and Blue River) was prepared in September 1994. The BA for Cougar was amended in October 1999, and a Biological Opinion (BO) was issued jointly by USFWS and NMFS on March 8, 2000.

4.0 DESCRIPTION OF THE ACTION TO DATE

4.1 Diversion Tunnel Construction. Activities to re-open the main diversion tunnel began in August 2001. The tunnel was lined with concrete, and gates to control flow were installed. The plug installed after completion of Cougar Dam was removed in stages. Construction runoff water was diverted into settling ponds prior to release into the South Fork McKenzie River.

4.2 Tunnel Tap. The final stage in opening the diversion tunnel was the "tap" which occurred on February 23, 2002. As the last of the concrete plug was blasted out, a torrent of 3,500 cfs of water from the bottom of the reservoir flowed out of the tunnel and down the South Fork McKenzie for about 45 minutes. The tap was observed by Corps staff and representatives from ODEQ, ODFW, NMFS as well as the press. The tunnel gates were closed for tunnel inspection, then reopened to prepare for drawdown at a slower rate.

4.3 Drawdown. Once the diversion tunnel was open, reservoir drawdown began at a rate of 3 feet per day. This was the maximum drawdown rate geotechnical staff believed was safe to avoid slumpage and possible damage to the dam (See FDM). A major rainstorm that produced approximately 3 inches of precipitation in the watershed above Cougar Reservoir over a 24-hour period occurred on April 13, 2002, delayed completion of reservoir drawdown. Drawdown was halted on May 26, 2002, at elevation 1,400 feet (instead of 1,375 feet as originally planned) due to the occurrence of unexpectedly high turbidity levels during drawdown. Stopping the drawdown process early was implemented to reduce river turbidity levels. Water cleared to less than 15 NTUs within 20 days. Termination of drawdown at 1,400 feet slightly increased the risk of flooding the construction area during the construction period.

4.4 Intake Tower Construction. Construction of the temperature control modifications to the existing intake tower is expected to take 3 years. Actions to date have included 1) diverting Rush Creek from the intake tower construction area; 2) foundation preparation work, to include rock blasting, excavation, and hauling of excavation material; 3) construction of a concrete cofferdam to protect the intake tower construction area from flooding; and 4) demolition of the fish horns, trash structure, and trash structure access bridge.

4.5 Environmental Coordination Committee (ECC) Meetings. In keeping with the commitment made in the FR/EIS, an Environmental Coordination Taskforce was established as a committee. The ECC is composed of staff from various Federal and State agencies, the McKenzie Watershed Council and Eugene Water and Electric Board (EWEB). The ECC has met quarterly, or more often if necessary, throughout final design and construction work. Most meetings are on site at the Cougar Project.

4.6 Water Quality and Sediment Monitoring. Construction activities and changes in the way the project is operated could impact water quality in the reservoir and in the river below the reservoir. To meet Corps policy, and the Clean Water Act, monitoring of water quality at project during construction was necessary. In consultation with the resource agencies, the Corps developed a water quality monitoring program that was implemented the year before construction began. The monitoring will continue for the 3 years of construction and during 1 year post construction. Monitoring sites were set up above and below the reservoir at the USGS gage stations and at three sites on the reservoir.

The Corps contracted with the United States Geological Survey (USGS) to re-establish the upstream monitoring gage (gage 14159200) and re-furbish the downstream gage (gage

14159500) on the South Fork McKenzie. The upstream gage measures water elevation (discharge is calculated), temperature and turbidity; the downstream gage measures water elevation (discharge is calculated), temperature, turbidity, dissolved oxygen (DO) and DO percent saturation. These gages have been in place since November and December of 2000 and operate continuously, reporting measured parameters as an average over every half-hour. The turbidity gages are sensitive to anything that reduces light, such as chemicals, sediment and organic particles, algae and, occasionally, insects or debris that can block the path of light. Unusually high turbidity readings may also result from fouling of the instrument, so it requires frequent maintenance. Three additional monitoring gages were established in 2003. One is on the McKenzie above the confluence with the South Fork; one is on the McKenzie at Vida ; and one is on Blue River below Blue River Dam. USGS maintains a website for data collected at these gages at http://oregon.usgs.gov/mckenzie/monitors.

The Corps contracted with the USFS, Blue River Ranger District, to monitor water quality in the reservoir before and during construction of the selective withdrawal project. The USFS collects data from April through November at three sites on the lake – near the withdrawal tunnel, the East Fork arm and the South Fork arm. In 2000 and 2001 the reservoir was sampled monthly, and in 2002 bimonthly. A Hydrolab instrument is used to profile the reservoir from surface to bottom at the three sites. Parameters measured are depth, temperature, dissolved oxygen, dissolved oxygen percent saturation, pH, specific conductivity and turbidity.

To assess whether the turbid water from drawdown contained contaminants associated with sediment, the Corps contracted with the USFS to collect water samples for analysis. During drawdown of the reservoir to construction pool elevation, the USFS collected water grab samples for chemical analysis from the South Fork at the gage sites above and below the reservoir (one and four samples, respectively), and in the mainstem McKenzie River at Hayden Bridge (three samples).

The water samples were collected on three dates: May 15, June 3, and June 17, 2002. These were sent to Severn Trent Laboratories (STL) for analysis of contaminants including 17 metals, 18 polynuclear aromatic hydrocarbons (PAHs), 26 organophosphorus pesticides, 12 chlorinated herbicides, 20 organochlorine pesticides, 5 anions, total organic carbon (TOC), biological oxygen demand (BOD), color, conductivity, cyanide, fecal coliforms, hardness, total dissolved solids (TDS), and turbidity.

To determine the physical nature of the turbid water and the potential for siltation downstream of the dam, the Corps asked the USFS to collect water samples at the above sites for analysis of Total Suspended Solids (TSS) and grain size distribution. Analyses of the samples were carried out by the USGS Volcano Observatory Lab in Vancouver, Washington. Samples were collected according to the schedule in Table 1 below.

During August, an algae bloom developed in the reservoir. This is a typical annual event but because of the smaller size of the pool and the visual appearance of the bloom the Corps had the USFS collect water samples for species identification and cell density determinations. These analyses were performed by Mr. Jim Sweet of Aquatic Analysts.

Table 1 Water Quality Samples

Sample #	Site Description	Date-time	Turbidity (NTUs)
CUGRUS	gage 14159200 US of res	5/15/02-1400	0.5
CUGRDS1	gage 14159500 DS of dam	4/24/02-0745	32.0
CUGRDS1d	gage 14159500 DS of dam	4/24/02-0925	31.8
CUGRDS2	gage 14159500 DS of dam	5/2/02 -1500	95.8
CUGRDS3	gage 14159500 DS of dam	5/15/02-1510	86.0
CUGRDS4	gage 14159500 DS of dam	6/3/02 -0825	42.0
CUGRHB	M. R. at Hayden Br	5/15/02-1745	-
CUGRHB2	M. R. at Hayden Br	6/3/02 -0645	-

The results of the water quality monitoring effort, before and after drawdown, are summarized below and presented in more detail in Appendix A of this report.

4.6.1 Pre-drawdown water quality**.** The monitoring data from year 2001, before construction began, showed that water quality in the reservoir and in the South Fork above and below the reservoir is excellent, although temperature is sometimes higher than desired for salmonids. State Standards for temperature, DO, and pH are not violated; nutrients concentrations are low (See Hains, April 2000). At the upstream site, water temperatures did not exceed 60°F and turbidity was usually less than 5 NTUs with occasional spikes up to 324 NTUs during storm events. At the below dam site water temperatures never exceeded 60°F, turbidity rarely exceeded 50 NTUs and usually was below 10 NTUs, and daily minimum oxygen ranged between 7.4 and 11.6 mg/L. In August, during the warmest period in the reservoir, oxygen ranged from 8 to 15 mg/L, temperatures varied from 73°F at the surface to 47°F at the withdrawal outlet. These data support conclusions from earlier studies that indicate that Cougar Reservoir is somewhere between having a moderate amount of nutrients (mesotrophic) and very low nutrients (oligotrophic) and that the South Fork McKenzie river has excellent water quality with some temperature limitations.

4.6.2 Drawdown water quality - turbidity**.** Because of tunnel construction delays, drawdown of the pool was delayed and began on April 1 continuing to May 26, 2002. The results of turbidity monitoring below the dam at the gage station are shown in the graph below (Figure 2). At the gage about 0.5 miles downstream of the dam turbidity ranged from 1 to 379 NTUs. Median turbidity levels were 98 NTUs with the high of 379 NTUs occurring on April 28.

A factor that exacerbated the turbidity coming out of the lake was a storm event in the watershed above the project that caused inflows to increase up to 5,800 cfs on April 14, 2002 (Figure 3). This inflowing water was highly turbid and ran up to 327 NTUs at 05:00 AM. At this time, turbidity below the dam was 48.4 NTUs. Beginning mid-morning of the 14th, turbidity started to rise below the dam. At about 23:00 hours of the 14th turbidity increased to 135 NTUs. There was

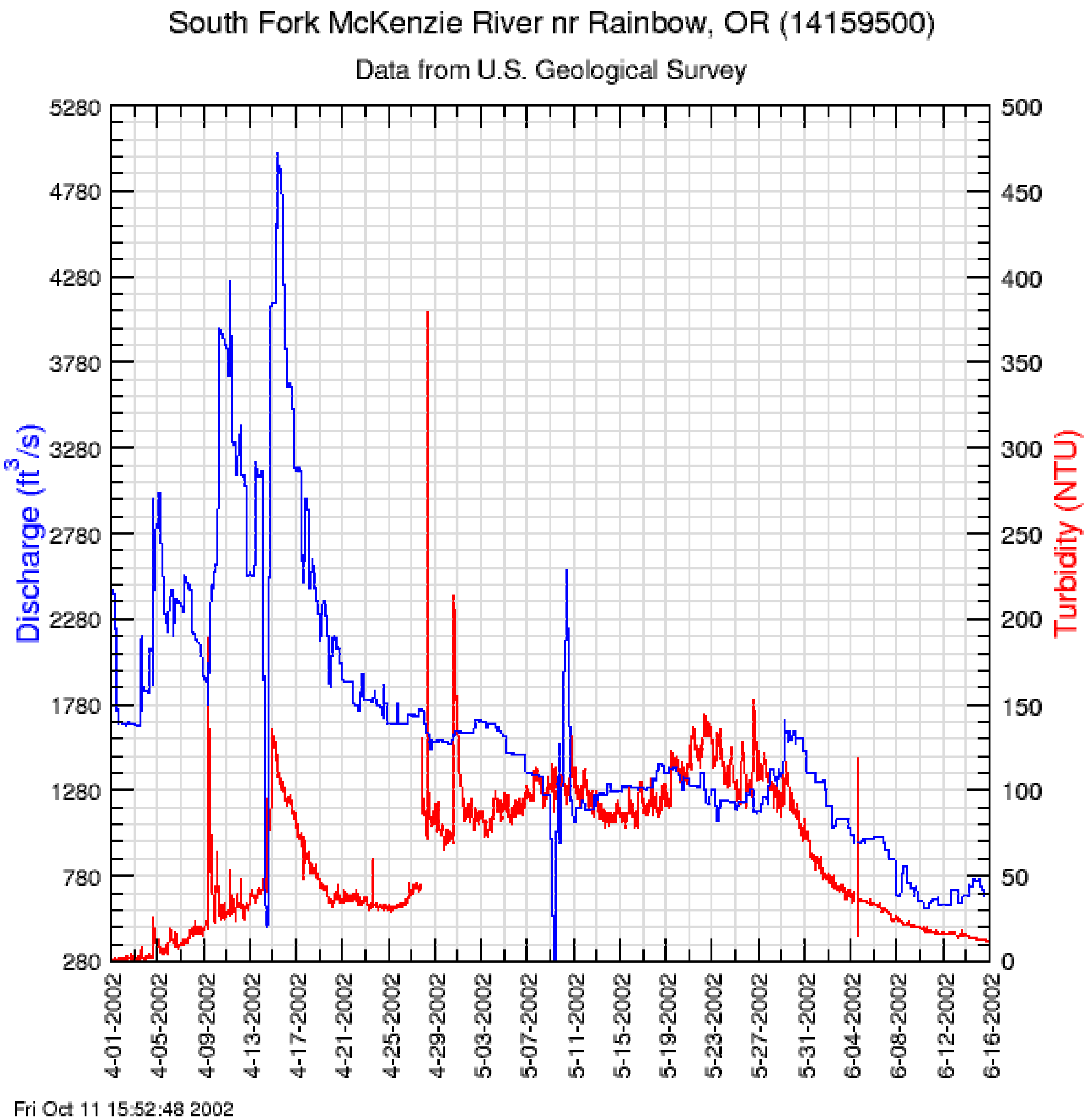


Figure 2. Discharge and turbidity at gage 0.5 miles downstream of dam during drawdown of 2002.

an 18 hour spread between the peak turbidity at the gage upstream of the reservoir and the peak turbidity downstream of the reservoir. After that, turbidity below the dam dropped gradually to around 30 NTUs 11 days later on April 25. If no dam had been in place during the early April storm event, we could have expected turbidity levels to have reached 300 plus NTUs in the mainstem McKenzie where the South Fork enters it. Prior to the dam, high turbidity events like this would have cleared quickly from the McKenzie system. Over the last 40 years one of the impacts of the dam has been to dampen these high turbidity events. The dam causes turbidity downstream from these events to be lower and spread over a longer period.

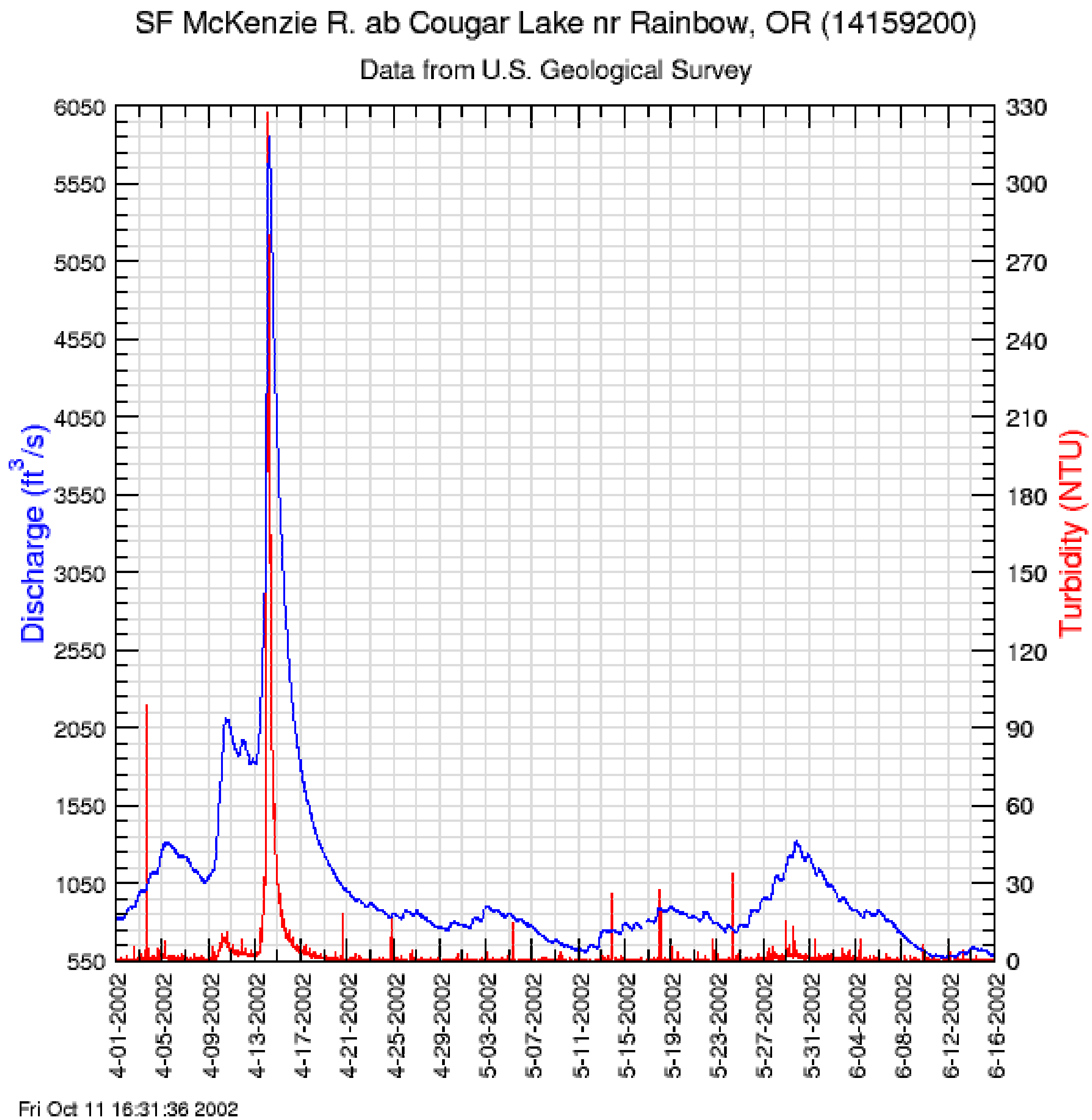


Figure 3. Discharge and turbidity during drawdown at the gage upstream of the dam.

Beginning on April 25 turbidity below the dam gradually rose to around 150 NTUs by the 26th of May. Over this period turbidity averaged around 100 NTUs. From the 26th of May to mid June there was a rapid drop in turbidity to less than 10 NTUs. Following the early April storm event it took about 6 weeks for the reservoir to clear up as drawdown proceeded.

For the duration of drawdown, higher than normal turbidity for this time of year was observed in the South Fork below the dam and in the mainstem McKenzie at least as far as Hayden Bridge near Springfield.

4.6.3 Drawdown water quality – other parameters. During drawdown, median DO in the South Fork McKenzie was 11.33 mg/L and median percent DO saturation was 98.8 percent. Neither violated State standards. Maximum temperature achieved was 49.6°F.

As stated earlier, samples were taken of the water coming into the reservoir and of the turbid drawdown water for analysis of metals, PAHs, organophosphorus pesticides, chlorinated herbicides, organochlorine pesticides, conventionals, Total Suspended Solids (TSS), and grain size distribution. A total of eight samples were taken between mid May and mid June of 2002 during a range of turbidities. No contaminants were detected above established EPA concern levels (EPA, 1986) in any sample. In one drawdown sample, CUGRDS1, taken at the gage below the dam when turbidity was 86 NTUs, 0.454 ug/L of diazinon and 0.155 ug/L of malathion were detected but not in a duplicate sample from the same site. A trace of DDT was detected in this sample at 0.000599 ug/L, which was also not confirmed in the duplicate sample. This DDT level is below the EPA freshwater acute (1.1 ug/L) and chronic (0.001 ug/L) water quality criteria for DDT. The lack of detection of malathion and DDT in the duplicate sample lends credence to the view that, if the chemicals were in the sample, they were there in very low concentrations.

Since there were no contaminants in concentrations above EPA concern levels in the eight samples, it appears that export of contaminants from the reservoir was minimal. Because DDT was found in reservoir sediment samples, more downstream samples will be taken in 2003 to determine whether DDT is being exported from the reservoir.

The organochlorinated pesticide beta-BHC was detected at 0.000562 ug/L in a sample taken of inflow water to the reservoir. This was also well below the acute water quality criterion of 100 ug/L for BHC.

The physical nature of the material in the turbid water released from the reservoir during drawdown was investigated. Table 2 below shows characteristics of sediment in drawdown water samples. Sediment in the drawdown samples was very fine-grained, with concentrations (21 to 85 mg/L, see Appendix A). For the seven samples an average of 92 percent of the material in the water was finer than the 62 micron (.062 millimeters) grain size that separates silt and clay from sand.

It was difficult to get enough sediment out of a sample for grain size distribution analysis. A hydrometer analysis done on a sample taken on May 15, 2002, at the gage downstream from the dam, when turbidity was at 86 NTUs, revealed that 99 percent of the sediment was smaller than 62 microns and 74 percent of that was in the clay size – 4 microns or smaller (31 percent was smaller than 1 micron; See Appendix A).

A bloom of blue-green algae usually occurs in Cougar Reservoir in August. This again happened in August of 2002. A total of 18 species were identified in the algae bloom. The bloom was dominated by the blue-green species *Anabaena flos-aquae* and *Anabaena circinalis*. Cell densities for *flos-aquae* varied from 9,160 cells/ml on August 7 to 139,066 cells/ml on August 19. The State of Oregon has not established an official standard for Anabaena cell densities.

Table 2 Grain size characteristics of sediment in drawdown outflow water samples taken below Cougar Dam and at Hayden Bridge

sample location	date	time	gage NTU	mg/L	sediment total	sediment sand mg/L	sediment fines	% finer than 62 microns
USGS gage above reservoir (CUGRUS)								
	5/15/2002	14:00	0.5	1.0	1.0	0.4	0.6	59
USGS gage below reservoir (CUGRDS)								
	4/24/2002	7:45	32.0	60.0	60.4	0.6	59.9	99
	4/24/2002	9:25	31.8	21.0	21.1	0.4	20.7	98
	5/8/2002	15:00	96.8	85.0	85.3	2.2	83.0	97
	5/15/2002	15:10	86.4	39.0	38.6	0.5	38.0	99
	6/3/2002	8:25	42.2	26.0	25.8	0.2	25.6	99
Hayden Bridge (CUGRHB)								
	5/15/2002	17:45	11.4	12.0	11.7	0.1	11.7	100
	6/3/2002	6:45	6.0	8.0	8.1	0.7	7.4	92

However, recently, the State Health Department has recommended posting lakes where the cell density exceeds 15,000 cells/ml as recently happened at Diamond Lake and Hills Creek Reservoir.

4.6.4 Summary**.** Water quality was monitored above, in, and below the reservoir prior to, during, and after the tunnel tap and drawdown. Water quality in the South Fork and reservoir prior to the beginning of construction was very good. Temperature and oxygen levels met State standards. Construction activities and drawdown impacted water quality by increasing turbidity to high levels (median 98 NTUs during drawdown) below the dam. Other water quality parameters of concern, such as metals and pesticides, were below established concern levels - except for the possibility of a slight detection of DDT in one downstream sample that was not confirmed in a duplicate sample. The high downstream turbidity and detection of DDT in exposed reservoir sediment raised questions regarding the potential for export of sediment and DDT downstream of the project. Future studies will address these concerns. Although previous sampling of reservoir sediments found no DDT, this pesticide was sprayed throughout the watershed prior to its being banned in 1972, and still remains in surrounding forests. (See Appendix B.)

4.7 Fisheries Monitoring. The Corps' BA recognized that potential problems associated with implementation of the Cougar WTC project might impact fish and wildlife resources. As a result, a multi-faceted monitoring plan was developed and implemented. This plan included biological monitoring of fisheries resources.

The Corps has an Intergovernmental Agreement with ODFW to provide assistance to the Corps in developing and implementing the monitoring plan. Actions under the plan included 1) collection of bull trout life history information prior to initiation of, and concurrent with, construction activities; 2) monitoring distribution, abundance and behavior of bull trout within and above the Cougar residual pool during construction; 3) monitoring for potential stranding, and rescue, of fish during drawdown of Cougar Reservoir; 4) monitoring distribution, behavior and condition of fishes below Cougar Dam before and during construction; 5) transport of spring chinook salmon and bull trout to above the residual pool during construction; and 6) development (and potential implementation) of a rescue plan for bull trout as an alternative to continuing use of the residual pool as a sanctuary area. Following the high turbidity events during Spring 2002, the Corps also collected data regarding structure and integrity of aquatic macroinvertebrate communities and habitat above and below Cougar Reservoir in the South Fork McKenzie River and in the mainstem McKenzie River.

Prior to drawdown of Cougar Reservoir, the Corps initiated studies regarding the behavior and distribution of bull trout above Cougar Dam. From these studies, ODFW has provided information to the Corps and to the ECC that has been helpful in evaluating project management options and in avoiding impacts to this species. These studies will continue throughout the construction phase of the Cougar WTC project and for 1 year following construction. Details of these studies can be found in the BO.

Prior to the bypass tunnel tap on February 23, 2002, ODFW placed live cages containing hatchery rainbow trout in strategic locations below Cougar Dam in order to monitor the effects of turbidity and other water quality conditions during the tap. ODFW also floated the river prior to, and following, the tunnel tap.

ODFW monitored conditions in the residual pool and below Cougar Dam during, and following, the drawdown of Cougar Reservoir. Drawdown was initiated on April 1st and completed on May 26th. ODFW has continually monitored the residual pool above Cougar Dam and the South Fork McKenzie River downstream of Cougar Dam for potential impacts of construction activities on bull trout, spring chinook salmon or other fish species. During and following drawdown, ODFW collected and assessed the health of wild fishes from several sites in the McKenzie River Basin. Results of these monitoring efforts are reported in quarterly monitoring and annual progress reports. If unusual mortality (e.g., other than normal post-spawning mortality) to spring chinook salmon, bull trout or other fish species is observed, NMFS, USFWS and ODFW are advised by the Corps; an attempt to determine causative factors is initiated; and the results of the investigation are documented. If causative factors are associated with Cougar WTC project activities, the Corps or the Corps's contractor implements BMPs and takes whatever immediate corrective action is necessary and appropriate to resolve the situation. The Corps consults with and advises NMFS, USFWS and the ECC, accordingly.

4.8 Spotted Owl Monitoring. A pair of northern spotted owls nest near Rush Creek and Cougar Reservoir intake structures. The Biological Opinion (BO) issued on March 8, 2000, requires noise monitoring for the Federally listed threatened northern spotted owl, and specifies that noise levels must not exceed 60 dBA (leq) during construction and must not exceed 90 dBC (peak) during blasting. Monitoring is required when construction occurs during the nesting season, from February through August.

To not disturb owls, a noise monitoring station was established to determine noise levels during construction. Minor construction activities were conducted during early February of 2001 and no blasting occurred during this time. Construction activities consisted of off-loading dive equipment from barges onto trucks and movement of trucks. Monitoring was conducted during 1-hour periods selected during noisier times of construction on February 1, 2, and 6. Average noise levels were noted on a minutely basis during each of the three 1-hour monitoring periods and dBA (leq) were below 60 for each minutely record for each of the 3 days of construction. Therefore, construction activities complied with noise requirements identified in the BO. Noise is monitored by Corps Operations staff and contractors, and reported to District Office wildlife biologists.

Monitoring of nesting activities of spotted owls was conducted by Dr. Steven Ackers of H.J. Andrews Experimental Forest. Two young were produced during 2001 and both were banded. The Rush Creek pair did not nest in 2002. The previous male was replaced by a new male that was originally banded as a juvenile more than 8 miles to the north in 1996. The female was the same one that has been there for 9 years (this was the 10th year). The pair did nest in 2003 and fledged two young.

Blasting during 2002 occurred during September after the nesting season, and therefore did not require monitoring per the BO.

4.9 BMPs Implemented. Best Management Practices (BMPs) are defined by EPA as permit conditions used in place of or in conjunction with effluent limitations to prevent or control the discharge of pollutants. They may include schedule of activities, prohibition of practices, maintenance procedure, or other management practice. BMPs may include, but are not limited to, treatment requirements, operating procedures, or practices to control plant site runoff, spillage, leaks, sludge or waste disposal, or drainage from raw material storage. The Corps implemented BMPs appropriate for construction within a reservoir relative to Section 402 of the Clean Water Act. As conditions changed, the Corps added BMPs when feasible. For example, when a temporary bridge was constructed across the South Fork McKenzie, rounded river rock from within the McKenzie River Basin, instead of commercial gravel, was used to support five large culverts. When the culvert bridge was removed, the river gravel remained to replenish natural spawning gravel supplies in the river. When turbidity from the drawdown was perceived as a problem, drawdown was halted at elevation 1,400 feet, reducing the drawdown period by 9 days. Although this increased the risk of storm-caused flooding of the intake construction area, it was implemented as a BMP to reduce the period of turbidity.

4.10 Public Information Meeting. On May 22, 2002, the Corps held a public information meeting at Walterville, Oregon, to discuss issues, especially turbidity, resulting from construction at Cougar. About 300 people attended and were provided an opportunity to express opinions and ask questions. The Corps set up a website (https://www.nwp.usace.army.mil/issues/wrtcp/) to address results of the meeting. Identified concerns were described and responded to within the web site.

4.11 Public Review Meeting. The Corps held a public meeting on February 12, 2003, at Walterville, Oregon, to discuss the findings of the SIR, accept public comment on the SIR and EA amendment, and to explain the events of January 30 when the Rush Creek outlet failed. About 80 people attended.

5.0 PROPOSED MANAGEMENT OPTIONS FOR REMAINING CONSTRUCTION

The options available for reducing the high spring turbidity associated with drawdown are 1)increasing the drawdown rate below pool elevation 1,532 feet, 2) adjusting the winter flood control pool elevation, and 3) adjusting the target date to reach construction pool of 1,400 feet. Due to the Rush Creek outlet failure, another option, maintaining the winter flood control pool and the construction pool at 1,450 has been added.

5.1 Discussion and Evaluation of Options. The range of options available for reducing the high spring turbidity were combined into six alternative operational plans. A target date of March 1 for drawdown to 1,400 is desired, as it gives a month to flush out any residual turbidity in the lower pool. Table 3 summarizes the alternative plans studied.

Table 3 - Cougar SIR Operational Alternative Plans*

Alternative	Target date	Drawdown rate	Winter Pool Elev.
LP1	-	3 ft/day	1400 ft
LP2	-	6 ft/day	1400 ft
HP1	March 1	3 ft/day	1532 ft
HP2	April 1	3 ft/day	1532 ft
HP3	March 1	6 ft/day	1532 ft
HP4	April 1	6 ft/day	1532 ft

*Maintaining the pool at 1,450 feet was not analyzed as an alternative.

Advantages and disadvantages for maintaining the pool this winter at or near elevation 1,400 feet are listed below.

Advantages:

- Widening and armoring of existing channel feeding lower reservoir pool due to winter flows, reduced risk of old channel abandonment/new channel formation.
- Higher probability of reaching elevation 1,400 by March 1 if there is a high-water event during the winter. This is because of the lower residual pool elevation prior to the high-water event (i.e., there is a higher probability of having a lower pool elevation after storing a flood).
- During the winter, a shorter timeframe for flushing turbid water from the residual pool because of the lower volume and detention time.
- Vegetation established below 1,532 feet during summer 2002 would not be drowned out, and become better established. This would reduce erosion in the lower pool, thereby reducing sources of turbidity within the reservoir. Turbidity in succeeding years would be reduced as a result.

Disadvantages:

- Higher turbidity during the winter. Increased number of turbidity events and increased turbidity associated with each event. Rapid rises in the pool level during winter storms will result in erosion of exposed sediments surrounding the residual pool.
- Higher and more variable flows downstream of the reservoir during the winter.

Advantages and disadvantages for filling the reservoir to elevation 1,532, then drawing it back down again in mid-January are listed below.

Advantages:

- Reduced probability of turbid flows below the dam during the winter if the reservoir fills with clear water, or following clearing of turbidity from the reservoir after it fills.
- Reduced or more normal winter turbidity downstream of Cougar reservoir during the filling period.

Disadvantages:

- Increase in risk that a new channel could be formed during the next drawdown to 1,400 feet. The new channel would cut through erodable material in the mid pool area transporting more material to the lower reservoir pool, increasing turbidity of the pool overall.
- Higher risk of increased turbidity below the dam during the spring as sediment re-distributed and deposited in the reservoir channel during inundation is re-suspended during drawdown.
- Lower probability of reaching el. 1,400 by March 1 if there is a mid-January or mid-February high-water event. A high-water event in mid-January or mid-February would impact the timing and duration of drawdown increasing the chance of turbid flows in the spring.
- Longer timeframe for flushing turbid water from the reservoir over winter because of the larger volume and longer detention time. However, turbidity would not peak as high.

In order to assess the potential effects of the six proposed operational plans on the McKenzie River system and Blue River Reservoir, system analysis was performed using HEC ResSim, a computer model capable evaluating the proposed operational criteria. Appendix C contains a technical summary of the modeling and results.

The results of the modeling determined the probability of reaching the target construction pool on March 1 under the six alternatives. Table 4 summarizes the results.

The two alternatives with the best chance of reaching a pool elevation of 1,400 feet are HP3 and LP2. In HP3, when the reservoir pool is raised to elevation 1,532 feet, it would only be

Table 4 Cougar Pool Elevations (ft), 10-90 Percent Non-Exceedance Probabilities at March 1*

	10 %	25%	50%	75%	90%
HP1	1404	1405	1412	1443	1483
HP2	1454	1456	1457	1460	1488
HP3	1401	1403	1406	1412	1455
HP4	1454	1456	1459	1461	1472
LP1	1400	1401	1404	1435	1464
LP2	1396	1400	1403	1407	1447

*Maintaining the pool at 1,450 feet was not analyzed as an alternative.

maintained at that elevation for about 6 weeks. As such, most of the benefits of keeping the reservoir pool at elevation 1,532 feet may not be realized. In addition, the difference between the two alternatives is only significant for an average or below average water year. An above average water year does not significantly favor either alternative. Given the number of advantages for maintaining the reservoir pool at or near elevation 1,400 feet, the preferred operational alternative is to keep the pool at or near elevation 1,400 feet for the duration of the construction project using a drawdown rate of 6 feet/day below elevation 1,532 feet (LP2).

5.2 Preferred Option for 2003/2004 Due to the Rush Creek outlet failure, the preferred alternative for operation of Cougar Reservoir during the winter and spring of 2003 and 2004 is a modified low pool/6 feet/day drawdown option. The Corps will attempt, as much as possible, to maintain the pool at elevation 1,450 feet during the winter. When the pool exceeds 1,450 feet, then drawdown will be at the 6 feet/day rate. If the winter is wet, or if heavy rain occurs during the late winter/early spring, the pool elevation will be above 1,450 feet for short periods.

With the pool maintained at this higher elevation the following could occur:

- An increased risk of flooding the construction site by overtopping the cofferdam at 1,495 feet during the construction season (13.7 percent vs. 7.8 percent).
- An increase in the relative time it takes to clear the reservoir of turbid water caused by erosion occurring within the reservoir. The volume of water the reservoir holds at 1,450 feet is approximately three times greater than at 1,400 feet. It would take longer to clear the reservoir of the turbid water, extending the duration of the turbidity downstream.

The effects on erosion and sedimentation processes within the reservoir by operation of the pool at the 1,450 foot level versus 1,400 feet are:

- A likely decrease in slope failures in the lower pool. Several localized slope failures were observed after the late January storm. Changes in pool elevation would be smaller for a 1,450 foot pool given the higher storage capacity above 1,450 feet.
- More of the exposed fine sediment deposits are covered at a 1,450 foot level, thereby exposing less material to resuspension and transport downstream. (O'Brien, et al. 2003)

5.2.1 BMPs for Subsequent Drawdowns. Based on present information, the adopted operation for 2003 will be maintained. The 2003 operation will be closely monitored. The operation will be further modified if needed.

5.2.2 BMPs After Drawdown. After drawdown is complete each year, beginning on or after March 1, BMPs to reduce turbidity will be evaluated. These include improvements to the upstream channel and operational changes to managing the reservoir.

5.2.3 Operation of Blue River Reservoir. Operations at Blue River reservoir will be essentially unchanged due to construction activities at Cougar. During the spring and winter, Blue River reservoir will be operated for flood control. Releases will be closely coordinated with outflows from Cougar reservoir. During the summer months, flows from Blue River may be used to dilute turbidity spikes in the mainstem McKenzie River that result from storm events at Cougar Reservoir.

6.0 DESCRIPTION OF ACTIONS TO BE COMPLETED

Construction of the Cougar intake tower modification is proceeding. Actions completed included slope reinforcement, diversion of Rush Creek, demolition of selected tower features, excavation of the tower foundation area, and construction of the cofferdam, which will help to protect the work site from flood events that may occur over following construction seasons. The tower modification is 30 percent completed as of late Spring 2003. Construction remaining to be completed includes final modification of the intake tower. This activity will require maintenance of Cougar Reservoir at the residual pool elevation of 1,450 feet during construction periods in 2003 and 2004.

The in-water part of a temporary fish trap below the dam has been constructed. Construction of the upland part of the trap has been suspended due to cost and operational changes since the BiOp (Reasonable and Prudent Measure 5) requiring the trap be constructed. Specifically, the residual pool was drawn down to elevation 1,400 and is currently being operated at elevation 1,450, as opposed to elevation 1,375, the elevation upon which the joint opinion was based. Biological monitoring suggests that high summer water temperatures in the residual pool have not materialized, nor has high turbidity significantly affected bull trout health. While there has been some emigration of bull trout through the diversion tunnel, it does not appear that this has resulted in mortality at significant levels. In addition, the emigration has been managed through incremental adjustments in our ongoing biological monitoring program. When considering this information in the context of growing budgetary constraints, it does not appear reasonable for the agency to make this level of investment in a temporary facility.

The Corps has the discretion to review and recommend changes to uncompleted authorized projects. This can be accomplished through preparation of limited reevaluation and post-authorization change reports. To date, we have not formally reviewed the need for changes in ongoing fisheries management at the Cougar project with an operating temperature control system in place. We believe it is necessary to conduct this review now under the Willamette Temperature Control project. If the review indicates a need for permanent trapping facilities that are clearly tied to environmental changes occurring as a result of the authorized temperature control project, then we have the discretion to recommend changes and request approval to add a permanent trap or other features to the ongoing project.

6.1 2003 Drawdown and Construction. To reduce the intensity or duration of another high turbidity event during April such as occurred in 2002, the Corps investigated possible operational changes. The options currently under consideration include alternative scenarios for winter pool operation, alternative timing for drawdown, and adjusted rates of drawdown. Analysis and observation of conditions during the 3 feet/day drawdown has lead the Corps to consider a faster drawdown of up to 6 feet/day. The Corps geotechnical staff believes that a drawdown rate higher than 6 feet/day could cause excessive slumping of shoreline and possible damage to the dam.

6.1.1 Water Quality Monitoring. Ongoing water quality monitoring will be continued at the gage sites above and below the project and in the reservoir. This monitoring was detailed earlier in this SIR report.

During the 2003 drawdown additional water quality monitoring is being considered that will provide information about outflow turbidity-suspended sediments relationships, deposition of sediment downstream, and export of DDT downstream. To accomplish this, suspended sediments in turbid water will be measured. The concentration of DDT in a range of turbid waters will be measured. Sediment traps will be set out to observe the extent to which settling of sediment occurs at downstream locations. Because of so few winter storms in 2003 and because of late receipt of FY 03 appropriation, the sediment trap studies could not be conducted this year. They are still under consideration for 2004, subject to the availability of funding.

6.1.2 Biological Monitoring. Ongoing biological studies (i.e., regarding bull trout behavior and distribution) and monitoring of potential impacts on fish and wildlife resources will be continued for 1 year following construction. These monitoring efforts are detailed in the BA and BO for the Cougar WTC project and are summarized above.

6.2 2004 Drawdown and Construction Actions proposed for 2004 are a continuation of the 2003 operation, with additions of new BMPs if any are identified.

7.0 NEW CIRCUMSTANCES SINCE THE EARLIER NEPA DOCUMENT

7.1 Turbidity. The Corps addressed the issue of turbidity during drawdown of Cougar Reservoir and during construction of the water temperature control feature in the Cougar Final Feasibility Report (FFR) and EIS. This report stated that turbidity levels in outflows could exceed 100 NTUs (Corps, 1995, FFR p90 and A-39, and EIS pp3-13 and 4-16) and inferred that levels of

200 to 600 NTUs were possible (FFR, p89, 4th par and p90, 2nd par). It was stated that turbidity would be an "unavoidable adverse impact" (EIS, p4-47).

In the EIS, the estimated impact to the mainstem McKenzie River was based on drawdown occurring in late winter, when high turbidity would normally occur because of storm events. Unfortunately, because of bypass tunnel construction delays, drawdown did not occur until spring.

Based on prior Corps experience with drawdown of Fall Creek Reservoir, the intensity of the turbidity event occurring during drawdown of Cougar Reservoir was expected to be relatively low and its duration was expected to be relatively short. Estimates of turbidity that would result from drawdown of Cougar Reservoir were based on up to 10 times turbidity levels actually measured in the reservoir (i.e., up to 10 times levels of 0.6 to 2.9 NTU).

The BA stated, "This turbid water would be discharged for a period of unknown length during initial drawdown of the reservoir, but the turbid discharge would likely occur over a relatively short term period (e.g., 10 days or less) based on observations at other impoundments in the Willamette Basin." This assumption was based on complete drawdown of Fall Creek Reservoir during November and December or 1989 when levels of turbidity were elevated for approximately 9 days.

High levels of turbidity below Fall Creek Dam occurred only when the reservoir level reached bottom (USACE 1995). The operational plan for Cougar Reservoir was to retain a residual pool. This was, in part, to capture sediment and reduce turbidity levels occurring below Cougar Dam.

In addition, it was assumed that, while the fine sediments that would be passed to below Cougar Dam could remain in suspension for long distances downstream (possibly all the way to the ocean), turbidity would primarily affect only the South Fork McKenzie River. This is because the mainstem would dilute turbid waters entering from the South Fork (EIS, p4-17). This dilution did occur during the Spring 2002 drawdown, although turbidity in the mainstem was more noticeable than expected.

On average, the South Fork McKenzie River contributes approximately 20 percent of the mainstem McKenzie River flow below their confluence. Because of dilution and settling, the average turbidity downstream during Cougar Reservoir drawdown was changed from about 100 NTUs near the dam to about 11 NTUs at Hayden Bridge 49 miles downstream (EWEB, personal communication).

Although mainstem McKenzie River flow helped to dilute turbid water entering from the South Fork, the observed levels of turbidity immediately below Cougar Dam were far above the predicted level of up to 30 NTUs. For example, observed turbidity had a median value of 98 NTUs and a mean of 99.0 NTUs over the 33-day period from April 28-May 30. Further, the expected duration of 10 days for the period of elevated turbidity during drawdown was far exceeded by an actual period of 87 days (April 6-July 1), during which mean daily turbidity was above background levels of up to 10 NTUs.

The extent and duration of turbidity that the Corps estimated would occur during drawdown were clearly underestimated, raising concerns that the Corps may have also underestimated associated impacts. The Corps concluded in their BA that significant effects on aquatic resources would not occur based on much lower levels of turbidity than were actually observed during drawdown. In addition, impacts of turbidity on recreational fishing during the March through April fly-fishing season were unanticipated because levels of turbidity were estimated to be relatively low and of short duration below Cougar Dam. They were anticipated to occur during winter, and turbidity levels occurring in the South Fork were expected to be diluted further upon entry into the mainstem McKenzie River.

The higher than anticipated level and duration of turbidity that occurred during drawdown of Cougar Reservoir in the spring of 2002 impacted the local fishing industry. It also raised concerns regarding potential effects of sediment deposition on aquatic resources (e.g., fish, invertebrates, and habitat) and regarding potential re-suspension and export of contaminants (e.g., DDT) borne in the turbid water.

Leaburg State Fish Hatchery reported elevated levels of turbidity in their hatchery water supply. During this period, hatchery managers experienced problems with an increase in disease-related mortality in rainbow trout held at the hatchery. While the hatchery has had a continuing history of disease-related problems, the turbid water conditions caused by Cougar Reservoir drawdown could have exacerbated these problems. Raised levels of suspended sediment in the hatchery water supply may have contributed to stressing of the diseased fish and may have caused some adsorption of therapeutic chemicals to clay particles, thus rendering the chemicals less potent.

This SIR examines the events, circumstances, and related data collected to assist in evaluating the effects of the high turbidity levels experienced during the initial drawdown of Cougar Reservoir in the spring of 2002. It also examines management alternatives for avoiding or reducing the effects of drawdown during the remaining construction periods in 2003 and 2004. A summary and brief chronology of high turbidity events during Spring 2002 follows. Background (i.e., normal) levels of turbidity below Cougar Dam in the South Fork McKenzie River and in the mainstem McKenzie River rarely exceed 50 NTUs and are usually below 10 NTUs (Appendix A).

The maximum turbidity measured below Cougar Dam, which occurred immediately following the bypass tunnel tap on February 23, was 1,358 NTUs. This level decreased to about 8 NTUs within an hour. Over the 5-day period following the tunnel tap, data from the USGS gage located below Cougar Dam indicated mean daily turbidity levels ranging from 21.0 NTUs (Feb 25) to 3.8 NTUs (Feb 27). Mean turbidity over this period was 13 NTUs. Turbidity returned to normal background levels after February 27th until reservoir drawdown commenced in April.

During drawdown (April 1-May 26), turbidity ranged from 1 to 379 NTUs below Cougar Dam. Turbidity spiked over the period of an hour from approximately 20 NTUs to near 200 NTUs on April 9. Mean daily turbidities remained above 30 NTUs (averaging 76 NTUs) for 59 days, through June 6. This was 11 days following the termination of drawdown on May 26.

A week-long spike in mean daily turbidity below Cougar Dam ranged from 112.7 NTUs to 41.4 NTUs and averaged 73 NTUs from April 14-19 (6 days) following a heavy rain event above Cougar Reservoir on April 13. This rain event caused turbidities up to 327.3 NTUs in the South Fork McKenzie River above Cougar Dam that returned to a near-background level of 15 NTUs after only 2 days. These observations demonstrate the effect of the reservoir on turbidity in terms of reducing the intensity, but extending the duration, of high turbidity events below the dam in comparison to natural high turbidity events above the reservoir.

The period of highest turbidity occurred over a 33-day period from April 28 through May 30, 4 days following termination of drawdown. During this period, the South Fork McKenzie River was cutting a channel to the residual pool through the sediment wedge deposited in the upper area of Cougar Reservoir over 39 years of inundation. The residual pool elevation fell below the invert level of the regulating outlet on April 30. Following this date, all discharge from Cougar Reservoir was through the bypass tunnel. Mean daily levels averaged 99 NTUs during the 33-day period of highest turbidity.

In comparison, turbidity at the EWEB water treatment plant intake located at Hayden Bridge, 49 miles downstream on the mainstem McKenzie River, was reported to have reached a high of 26 NTUs, with an average of about 11 NTUs over April and May. This level resulted in the need for additional filtration of raw water during processing.

7.2 <u>Sedimentation</u>

7.2.1 Erosion and Sediment Movement within Cougar Reservoir. Drawdown of Cougar Reservoir below its normal minimum pool level of 1,532 feet to the construction pool level of 1,400 feet resulted in substantial erosion of unvegetated soil surrounding the pool. The major tributary drainage streams flowing into the reservoir, the South Fork McKenzie, East Fork McKenzie, and Walker Creek, re-established channels to the lower pool at the 1,400 foot level. These processes transported large amounts of sediment into the newly created residual pool area at 1,400 feet. Detention time in the construction pool was sufficient to allow the bulk of the coarser grained sediment mass to settle out. Much of the fine-grained sediment mass (silt-clay fraction, grain size smaller then 62 microns) was released from the reservoir during the period from April 1 to May 25, 2002 when the pool level reached 1,400 feet. The fine-grained material released from the reservoir caused extended elevated turbidity in the South Fork McKenzie to the confluence and into the mainstem McKenzie Rivers.

7.2.2 Suspended Sediment Concentration. In order to assess the environmental impacts of the extended period of high turbidity in the South Fork and mainstem McKenzie Rivers on fishes, estimates of suspended sediment concentration were made by the Corps (Appendix D). Estimates of suspended sediment concentrations over extended time periods in the South Fork McKenzie River below Cougar Dam may be made using the measured turbidity at USGS gage, number 14159500 near Rainbow, Oregon. The gage is located just downstream of Cougar Reservoir.

Equations for suspended sediment concentration (SSC) as a function of turbidity are developed using linear regression methods with SSC as the dependent variable and turbidity as the independent variable, and are commonly used to estimate SSC. The equations developed are site and watershed specific and are typically based on data collected over a wide range of streamflows and basin conditions. Many factors may influence the SSC – turbidity (SSC-T) relationship for any given site, such as the geology of the watershed, soils, vegetation, slope and aspect, and land use (Lewis, et al. 2002). The SSC-T relationship is also affected by the effects of sediment loading over time as exhibited downstream of reservoirs. In general, sediment discharge from reservoirs tends to be higher in fine sediment, as the coarser fraction settles out in the reservoir pool

To provide an estimates of SSC in the South Fork McKenzie River below Cougar Reservoir, the Corps used data from the USGS North Santiam River Basin Suspended-Sediment and Turbidity Study (Urich, et al. 2002). SSC-turbidity relationships were developed for five sites in the North Santiam basin. Three sites were located on tributary streams draining Detroit Reservoir and two sites, Mehama and Niagara were located on the North Santiam below Detroit Reservoir (Appendix D, Figure 1).

The Corps used the SSC-Turbidity relationship at Mehama, Oregon (USGS gage 14183000) to develop its SSC and sediment discharge estimates for the South Fork McKenzie river below Cougar Reservoir. The Mehama data were used because the site was located below Detroit Reservoir, and there is some similarity in the geology and watershed characteristics. In addition to these factors, the SSC samples (CUGRDS1-4) and corresponding observed turbidity (Appendix D, Figure 2) compared favorably with the Mehama data. As the SSC-turbidity relationship is site specific, use of the North Santiam data to estimate SSC and sediment discharge provides a gross estimate.

The computed mean suspended sediment concentration over the period from April 9 to June 6, 2002, was 48.5 mg/liter, the corresponding average turbidity was 76.1 NTU.
Five suspended sediment samples (CUGRDS1-4) were collected just downstream of Cougar Reservoir at the USGS gage at Rainbow, Oregon between April 24 and June 3, 2002. The suspended sediment concentrations (SSC) of these samples ranged from 21 to 86 mg/liter and were between 97 and 99 percent fine sediment (grain size smaller than 0.062 mm). The corresponding measured turbidity when these samples were taken was between 31.8 and 96.8 NTU.

7.2.3 Sediment Transport Analysis. Using the SSC-T relationship from Mehama, Oregon, the Corps estimated that approximately 12,500,000 kg (13,800 tons) of sediment was discharged over the same period. Applying a standard error, the estimate is between 4,530,000 kg (5,000 tons) and 20,500,000 kg (22,600 tons) (Appendix D). No estimate of sediment deposition over the period was made by the Corps. Visual observation of the South Fork McKenzie River gravel bed below Cougar Reservoir and of the mainstem McKenzie River below its confluence with the South Fork indicated the presence of a thin layer of silty material following the sustained releases of highly turbid water from Cougar Reservoir. Most of this material did not accumulate on the surface of the gravel bed but was flushed through the McKenzie River system during subsequent high flows. Some of the fine sediment in suspension accumulated in the algae covering the gravel bed, changing the color of the algae from green to gray.

7.3 Sediment Sampling and DDT.

During the design phase of the project, Geotechnical Resources Inc. submitted 12 surface grab sediment samples for physical and chemical analyses. These samples were collected at the 1,400' contour near the intake structure and diversion tunnel and upstream locations, with results published in the Design Memorandum No. 21. No organic contaminates were detected above method detection levels (MDL) and metals were detected only at low levels and were considered at background levels. However, with the greater than anticipated amount of turbidity during the drawdown process, questions were raised about potential contaminate levels in the turbidity and possible sediment releases, as a result additional sediment sampling was planned.

7.3.1 DDT in Sediment. As a result of questions raised about potential contaminate levels in the turbidity and possible sediment releases, 12 surface sediment samples, targeting fine-grained sediment and organic material, were collected in June 2002. These samples were collected to target fine-grain and organic material that had been eroded during the drawdown, with one sample to represent lakebed sediments exposed after the drawdown event. All samples were submitted for physical parameters including total volatile solids and five samples were chemically analyzed for heavy metals (nine inorganic), total organic carbon, pesticides and polychlorinated biphenyls (PCBs), phenols, phthalates, miscellaneous extractables and polynuclear aromatic hydrocarbons (PAHs).

7.3.1.1 June Event Results: Five samples were tested for pesticides and PCBs. No PCBs were found at the Method Detection Limit (MDL) in any of the samples. No pesticides (except DDT and derivatives) were found at the MDL in any of the samples. Two phthalate compounds were detected in one sample each, and the values were well below established levels of concern (see reference appendix B). No phenols were detected in any samples above MDLs. One miscellaneous extractable (n-nitroso-di-n-propylamine)(DPN) was found in one sample, COUG-G-07. This was not confirmed in the quality assurance (QA) split sample. This chemical is produced primarily as a research chemical and not for commercial purposes (Spectrum). DPN was not considered to be a chemical of further interest.

The following stations were tested for DDT and its breakdown components, DDE and DDD (expressed as Σ DDT) (with corresponding levels as indicated): two samples were collected from East Fork cut banks (Σ DDT @ 8.5 and 32.6 ppb), one sample below the Slide Creek boat ramp, from a cut bank area (Σ DDT @ 23.9 ppb), one sample from the Annie Creek delta (Σ DDT @ 18.6 ppb), and one sample was collected from lake deposits near the face of the dam on the Rush Creek side (Σ DDT @ 5.3 ppb).

7.3.1.2 August Event Results: Fifteen samples were collected and analyzed for physical properties, total organic carbon (TOC) and Σ DDT. Two background samples were collected from the South Fork of the McKenzie above the reservoir (no Σ DDT detected, less than 2.6 percent fines); three vertical profile samples from the cut-bank areas where only the fine-grained sediment was targeted in June (7.27, 7.11 and 17.65 parts per billion [ppb]); five surface composite sediment samples collected from the reservoir to represent the recently eroded and homogenized sediment during the drawdown event (non-detect [ND] @ 0.7 ppb detection level), 1.08, 4.77, 6.19 and 25.87 ppb). Each of these five samples analyzed were a composite of two to three surface grabs from a designated area of the reservoir; two surface samples from the McKenzie River, downstream of the dam (both ND @ less than 0.7 ppb) in slack water areas, where Σ DDT might have been deposited, if it had migrated beyond the confines of the reservoir. One upland station was sampled on a logging road cut bank. Samples represented the surface to 6" depth and 6"-12" depth of forest floor debris (Σ DDT @ 374.6 ppb top 6") and (Σ DDT @ 36.9 ppb 6"–12" depth). (For more details see attached sediment Appendix B).

It is likely that some floating organic debris (fir needles, twigs, etc.), binding DDT, was released from the reservoir during the initial drawdown, but this material was likely distributed over a very large area, and not measurable nor posing any significant exposure to organisms, due to the wide distribution of this material. Because Σ DDT is hydrophobic (little affinity for water) it will tend to remain bound to the organic material and not released to the water column. (See Appendix B.)

7.4 Oregon Chub.

In the fall of 2000 a viable population of Oregon chub, listed as endangered under the Endangered Species Act, was discovered in the lower McKenzie River near Springfield, Oregon. In addition, a small population of Oregon chub was discovered in the Mohawk River, a tributary of the McKenzie, known to contain agricultural runoff. A memorandum for the record has been prepared to address this discovery. The Corps determined that there would be no effect from construction on Oregon chub. USFWS concurred.

The Cougar WTC Project has the potential to impact Oregon chub residing in the lower McKenzie River through alteration of water quality, but would have no direct impact on Oregon chub located in the Mohawk River. While the project has at times contributed to increased turbidity in the lower McKenzie River, the magnitude of turbidity levels and associated effects has been small in comparison to those occurring below Cougar Dam in the South Fork McKenzie River (See Appendix A). For example, the highest level of turbidity reported by EWEB at their Hayden Bridge treatment facility was 11 NTUs when mean daily turbidity levels below Cougar Dam were averaging 99 NTUs.

Oregon chub are small fish and weak swimmers. Habitat where Oregon chub occur includes ponds and sloughs with little or no water flow velocity, with a depositional substrate of silt and organic materials, and with stands of filamentous algae and emergent aquatic, or overhanging riparian, vegetation as described by Pearsons (1989) and Markle *et al.* (1991). Modest levels of turbidity, such as those reported to have occurred at EWEB's Hayden Bridge plant during spring 2002, would have no adverse effect on these habitat types or on the fishes that occupy them. As a result, we determined that the Cougar WTC Project construction has had no effect on Oregon chub and is unlikely to have effects in the future. A "no effect" determination has, therefore, been made.

7.5 Analysis of High Turbidity on Spawning Gravel

The Corps contracted with the U.S. Forest Service (USFS) and Department of Geosciences at Oregon State University (OSU) to conduct an investigation of fine sediment deposition in spawning gravels of the South Fork McKenzie and McKenzie Rivers as a result of the drawdown of Cougar Reservoir. A study by Stewart et al. (2002) examined substrate core samples taken from the riverbed to evaluate intrusion of fine sediments into spawning gravels located above and below Cougar Reservoir.

In addition, Stewart et al. (2002) used clay mineralogy analysis to link clay found in core samples taken from the S.F. McKenzie River below Cougar Dam to clay found within Cougar Reservoir. It is not possible, however, to determine when the clay from Cougar Reservoir was deposited below the dam. Deposition could have occurred any time over the past 40 years. A clear linkage to Cougar Reservoir clays was not found in core samples collected from the mainstem McKenzie River, indicating that these deposits likely originated from a combination of sources, including Cougar Reservoir, over a relatively long time period.

Estimation of the specific quantity of sediment deposited in the area immediately below Cougar Dam in comparison to other areas located further downstream was not determinable. The analysis of sediment infiltration into gravel below Cougar Dam indicated that most sediment originating from Cougar Reservoir either before or during the high turbidity events of Spring 2002 was deposited in the South Fork McKenzie River before its confluence with the mainstem McKenzie River (Stewart et al. 2002). This analysis also indicated that the amount of material deposited decreases relatively quickly with distance below the dam.

Data specific to the McKenzie River system that could be used to estimate the relationship between suspended sediment concentration and turbidity was unavailable. As a result, the Corps used USGS data from below Big Cliff Dam on the North Santiam River and associated relationships to estimate suspended sediment concentrations (SSC) occurring in the McKenzie River from observed turbidity levels (Appendix D). From mean daily flow data and corresponding mean daily SSC estimates, the Corps calculated an estimate of the total sediment load that may have been discharged from Cougar Dam during the period April 1 through July 1, 2002. The Corps estimated that from approximately 5,000 to 22,500 tons (13,800 ± 8,800 tons) of fine sediment may have been discharged to below Cougar Dam. Turbidity measurements taken at Hayden Bridge near Springfield, in comparison to turbidity measured just below Cougar Dam, indicated that most of this fine sediment remained in suspension and passed downstream to below the McKenzie Basin.

An unknown portion of the material discharged from Cougar Dam was deposited in the McKenzie Basin. However, visual evidence of a light dusting of gray material on the streambed during and immediately following the high turbidity events of Spring 2002 indicated that at least some material from Cougar Reservoir was deposited throughout the entire McKenzie River system from Cougar Dam downstream. Some of this material will be re-suspended in the water column and washed further downstream during future high flow events occurring over winter. The quantity of material that may be washed from the McKenzie system will depend upon the quantity of fine sediment that was deposited and the depth at which it was deposited in relation to the intensity of over-winter flow events. Sediment deposited nearer the surface of the stream channel substrate will be the most easily re-suspended and moved downstream.

While accumulation of fine sediment has occurred below Cougar Dam over an unknown time period, the high turbidity events during Spring 2002 were unlikely to have had long-term negative impacts on spawning gravel quality below Cougar Dam. However, assessment will be made of the rate of fine sediment accumulation in gravel areas during future storm events over the winter of 2002-2003 to aid in better understanding the dynamics of fine sediment transport and deposition, and its effects on habitat.

7.6 Analysis of High Turbidity on Aquatic Macroinvertebrates

Aquatic macroinvertebrate (benthic) samples were collected above and below Cougar Reservoir in August 2002 following the high turbidity events of Spring 2002.(Figure 4) The sampling design was intended to determine if there had been immediate and catastrophic impacts to benthic invertebrate communities as a result of the recent drawdown of Cougar Reservoir. Where possible, data collected in August 2002 were compared with samples collected by the McKenzie Watershed Council in October 2000 and 2001, prior to the high turbidity events of Spring 2002.

All of the above samples were analyzed by Aquatic Biology Associates, Inc. (Wisseman 1996) according to a standardized and well documented procedure that produces, among other things, a Biotic and Habitat Integrity Index summary score (index score) for each sample site. The analysis procedure and resulting index score consider a combination of factors including 30 metrics for stream margin samples and 53 metrics for riffle samples. These metrics assess taxa (e.g., species) presence, diversity and abundance, and permit assessment of invertebrate community composition and structure. Results from samples collected in the McKenzie River Basin are presented in Figure 5.

Analysis indicated that the macroinvertebrate community below Cougar Dam was degraded (moderate to low index scores) in comparison to the community located above the reservoir (high to low index scores; Table 5). However, this is not unusual for areas located below dams. For example, total index scores for margin habitat immediately below all dams on the Clackamas River were significantly depressed (PGE 2002). This trend was also indicated in South Fork McKenzie River samples collected during 2000 and 2001, prior to drawdown of Cougar Reservoir (Figure 5).

It is likely that the low index score observed below Cougar Dam in August 2002 at Site 4 relative to sampling sites located above the reservoir is related more to total effects from the dam, rather than specifically to increased turbidity during Spring 2002 (Wisseman 2002). Alteration of the historic water temperature regime below Cougar Dam (the correction of which is the objective of the Cougar WTC project) has likely had a strong effect on the structure and integrity of the macroinvertebrate community there. In the Coordination Act Report to the Corps on the Cougar WTC project (April 12, 1995), the U.S. Fish and Wildlife Service pointed out that "where conditions have been altered such that temperatures are uniformly colder, lacking daily and/or seasonal fluctuations…aquatic insect populations are much less diverse (fewer species), with large numbers of individuals of a few species that are suited for these altered conditions" (Stanford and Ward 1983; Ward and Stanford 1979).

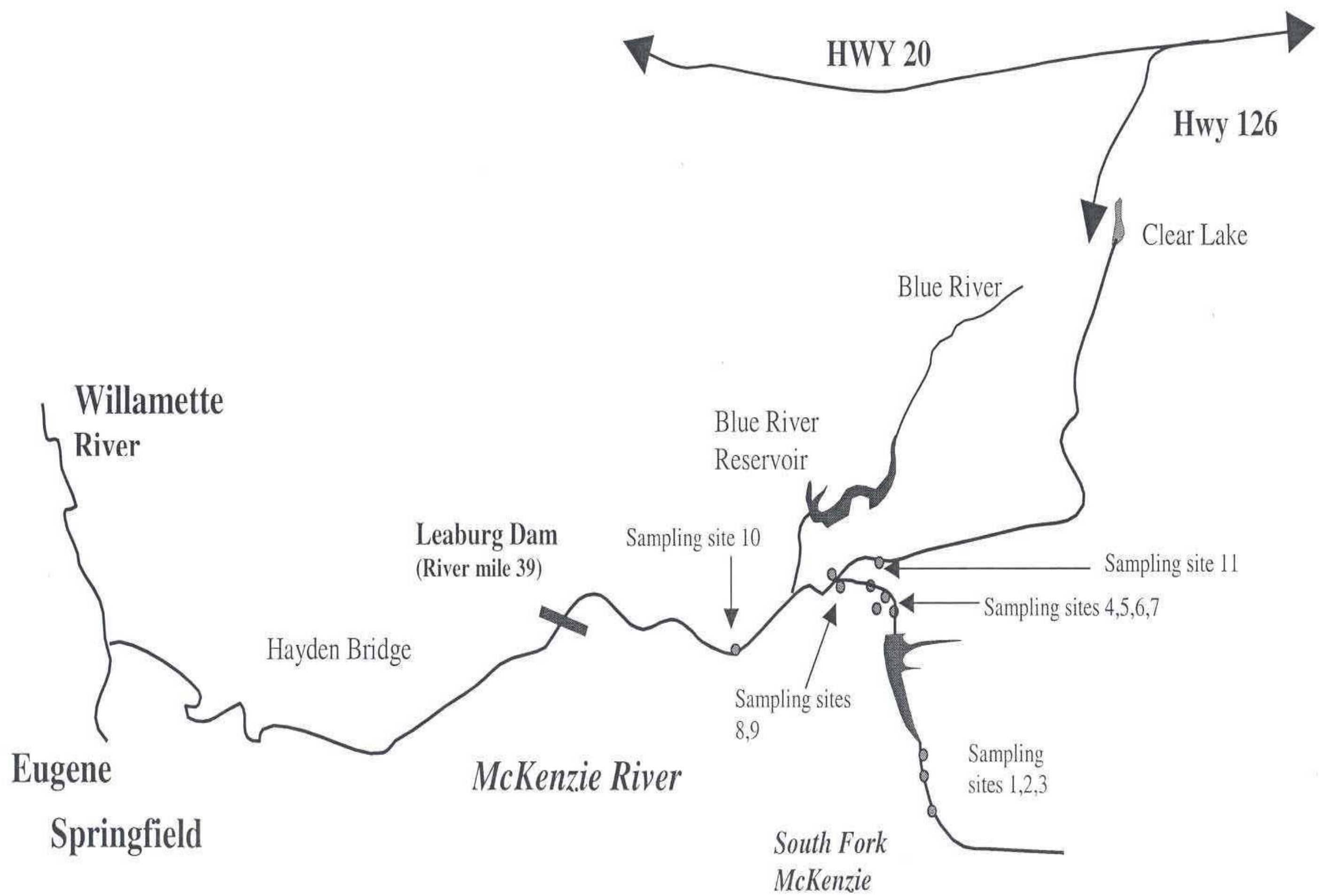


Figure 4

Macroinvertebrate Sampling Sites

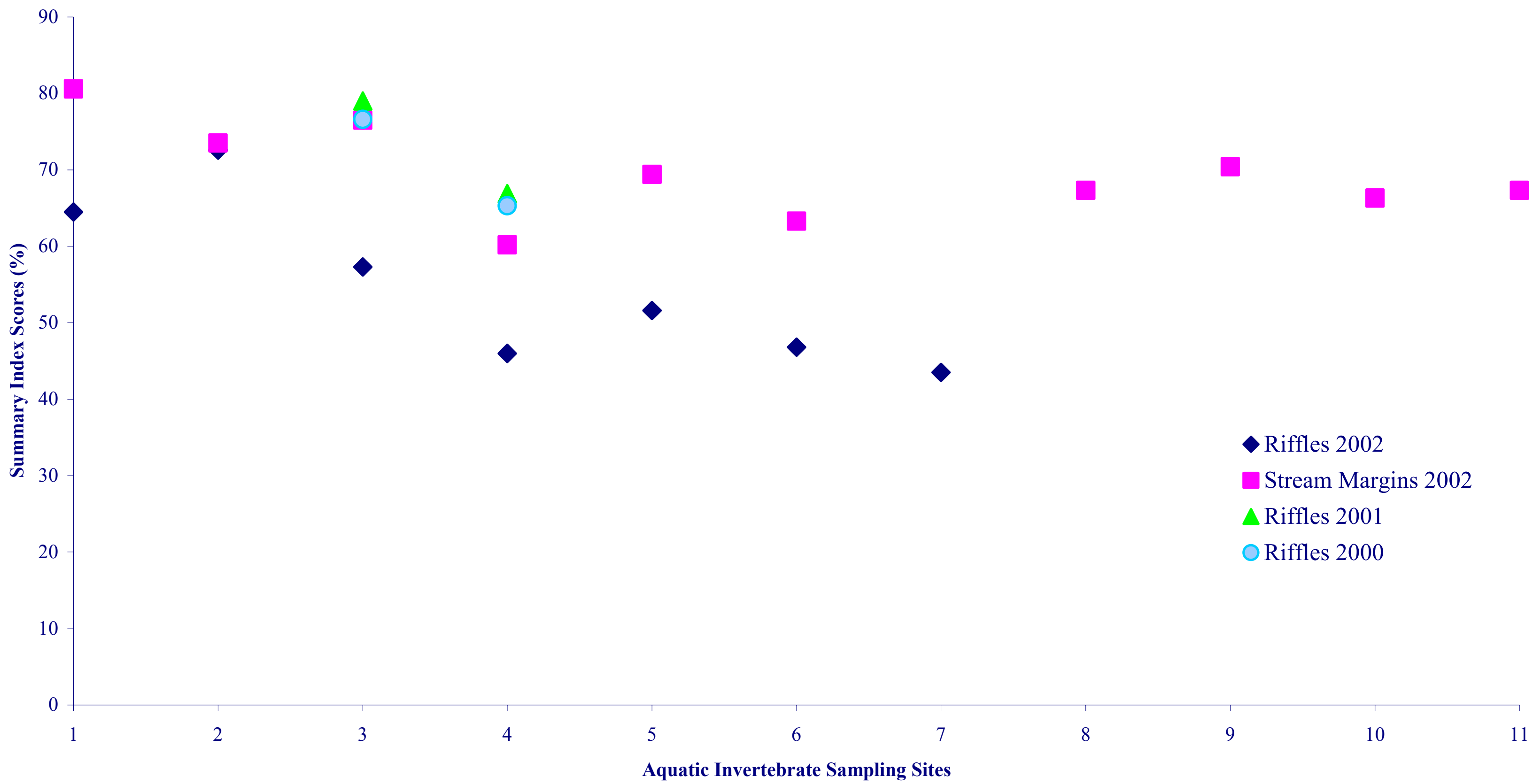


Figure 5. Plot of Biotic and Habitat Integrity Index summary scores (Wisseman 1996) for aquatic macroinvertebrate sampling sites in the McKenzie River Basin, Oregon.

Note: Site locations proceed from upstream to downstream. Sites 1-3 are located in the South Fork (SF) McKenzie River above Cougar Reservoir. Sites 4-7 are located in the SF McKenzie River below Cougar Dam. Sites 8 (right bank) and 9 (left bank) are located in the McKenzie River at its confluence with the SF. Site 10 is located downstream and Site 11 is located upstream of the SF confluence in the McKenzie River.

Table 5. Biotic and Habitat Integrity Index Summary Scores and Classifications (Wisseman 1996) for Aquatic Macroinvertebrate Sampling Sites in the McKenzie River Basin, Oregon.

Sample Site	Sample Year	Sample Type	Location	Index Score	Integrity Class
1	2002	R	SFA,U	64.5	Mod
1	2002	SM	SFA,U	80.6	Hi
2	2002	R	SFA,M	72.6	Mod
2	2002	SM	SFA,M	73.5	Mod
3	2000	R	SFA,L	76.6	Mod
3	2001	R	SFA,L	79.0	Mod
3	2002	R	SFA,L	57.3	Low
3	2002	SM	SFA,L	76.5	Mod
4	2000	R	SFB,U	65.3	Mod
4	2001	R	SFB,U	66.9	Mod
4	2002	R	SFB,U	46.0	Low
4	2002	SM	SFB,U	60.2	Low
5	2002	R	SFB,M	51.6	Low
5	2002	SM	SFB,M	69.4	Low
6	2002	R	SFB,L	46.8	Low
6	2002	SM	SFB,L	63.3	Low
7	2002	R	SFB,SCh	43.5	Low
8	2002	SM	MR,RB	67.3	Low
9	2002	SM	MR,LB	70.4	Mod
10	2002	SM	MR,B	66.3	Low
11	2002	SM	MR,A	67.3	Low

Samples were collected in October 2000 and 2001 and in August 2002 from either riffles (R) or stream margins (SM). Site locations include the South Fork McKenzie River above (SFA) and below (SFB) Cougar Reservoir and the mainstem McKenzie River (MR). Secondary codes indicate upper (U), middle (M), lower (L), and side channel (SCh) sites on the South Fork and sites on the mainstem McKenzie River above (A), below (B), and at the confluence of the South Fork with the mainstem on its right (RB) and left (LB) banks. Possible Biotic and Habitat Integrity Index classifications are very high (Vhi), high (Hi), moderate (Mod), low (Low) and very low (VLow).

The index scores for riffle samples collected in August 2002 were consistently lower than index scores for riffle samples collected in October 2000 or in October 2001 at sites both above (Site 3) and below (Site 4) Cougar Reservoir. This was likely an artifact of the difference in time of year during which the samples were collected (Wisseman 2002).

Index scores indicated that biotic and habitat integrity of macroinvertebrate communities located below Cougar Dam was fairly uniform with distance downstream. That is, habitat for these organisms and their community structure did not decrease significantly in quality near the dam in comparison to habitat located further downstream.

The index score for Site 11, located in the mainstem McKenzie River above its confluence with the South Fork, was not significantly different from the scores for Sites 8,9, and 10 located in the mainstem McKenzie River at, and about 6 miles below (Site 10), its confluence with the South Fork (Table 5; Figure 5). Because of its location, environmental conditions at Site 11 were not influenced by drawdown of Cougar Reservoir during Spring 2002. The lack of difference in this area from sites located further downstream in the mainstem McKenzie River suggests that degradation of the macroinvertebrate community in all of the areas sampled below Cougar Dam has proceeded over a relatively long time period and did not result from a catastrophic event associated with the recent drawdown of Cougar Reservoir. Further, the abundance of organisms, species diversity, and presence of species sensitive to high levels of turbidity that were found in aquatic macroinvertebrate samples collected from sites located in the South Fork McKenzie River downstream of Cougar Dam suggests that this area was not heavily impacted by the relatively high turbidity events of Spring 2002 (Wisseman 2002).

7.7 Analysis of High Turbidity on Fishes

Direct observations of fish condition were made in response to periods of high turbidity that occurred in the McKenzie River Basin during Spring 2002. These observations were made at multiple locations and times. The results of these observations are presented below.

While these direct observations were important for documenting fish condition, they are point-in-time (and space) samples of the fish community that are representative of, but not equal to, the full extent of impacts that may have occurred. Clearly, practical and logistical limitations prevented the Corps from sampling all segments of the fish community in all areas potentially affected.

In order to better assess the potential extent of impacts to fishes over space and time, available scientific literature was consulted as an aid. Newcombe and Jensen (1996) reviewed "80 published and adequately documented reports on fish responses to suspended sediment in streams" and developed empirical equations relating the biological responses of fishes to concentration and duration of suspended sediment exposure. The equation they developed for exposure of juvenile and adult salmonids to particle sizes ranging 0.5-250 μm in diameter was

$$Z = 1.0642 + (0.6068)\ln d + (0.7384)\ln c$$

where Z is a score indicating the types and severity of ill effects, ln indicates the natural logarithm (i.e., to base e) of the indicated parameter, d is the duration of exposure in hours, and c is the average concentration of suspended sediment in milligrams per liter (mg/l) experienced over time period d.

The Z scores developed by Newcombe and Jensen (1996) ranged from 0-14. The authors determined, for example, that a score of 10 indicates the likelihood of 0-20 percent mortality and moderate to severe habitat degradation. Scores above 10 indicate the likelihood of higher levels of mortality, while lower scores indicate lesser effects such as reduced growth rate (z = 9), major physiological stress and reduced feeding rate (z = 8), moderate habitat degradation (z = 7), moderate physiological stress (z = 6), or minor physiological stress and increased respiration rate (z = 5).

The *z* scores were determined using the above formula for key turbidity events and periods following the bypass tunnel tap and during the Cougar Reservoir drawdown. This approach was used as a means of assessing potential effects of high turbidity on spring chinook salmon, summer steelhead, rainbow trout or other salmonids present in the South Fork McKenzie River below Cougar Dam or in the mainstem McKenzie River below its confluence with the South Fork. In addition, the direct observations of the condition of fishes that were made during these events and periods by biologists and pathologists as a result of ongoing biological monitoring associated with implementation of the Cougar WTC project were helpful in confirming results obtained through determination of *z* scores.

In order to calculate *z* scores, suspended sediment concentrations (SSC) associated with observed turbidity levels (T) were estimated. Systematically collected data directly relating turbidity levels above or below dams in the McKenzie River Basin to suspended sediment concentrations were not available.

The Corps collected a few water samples at various sites in the McKenzie River Basin during the high turbidity events of spring 2002 (Table 1) The size range of particles contributing to suspended sediment in the water samples collected from the McKenzie River downstream of Cougar Dam (i.e., 0.5-250 µm in diameter) was identical with the range of particle sizes for which Newcombe and Jensen (1996) estimated effects on juvenile and adult salmonids.

Because of the limited number of samples (N=5) available from below Cougar Dam in the McKenzie Basin, data and equations from studies performed by the U.S. Geological Survey (USGS) in the North Santiam River (Uhrich et al., 2002) were used. This information was supplemented with analyses performed by the U.S. Army Engineer Research and Development Center, using sediment samples collected directly from Cougar Reservoir. The Corps concluded that the best relationship between suspended sediment concentration and turbidity for use in the McKenzie River Basin was given by the equation $SSC=1.90T^{0.752}$ for low to moderate turbidity levels and by the equation $SSC=0.55T+83.45$ for relatively high (greater than 200 NTU) turbidity levels (Appendix D). These equations were used to convert mean turbidity data into estimates of suspended sediment concentration for calculation of *z* scores.

To estimate the potential effects of turbidities observed during Spring 2002, the Corps determined *z* scores for each turbidity event based on the relationships of suspended sediment concentration to turbidity presented above and in Appendix D.

7.7 <u>Analysis of Tunnel Tap and Drawdown Events on Fishes</u>

The maximum turbidity recorded below Cougar Dam during the bypass tunnel tap on February 23 was 1,358 NTUs. This level of turbidity occurred at initiation of the tap and persisted for less than a half hour. Turbidity returned to near background levels of 8 NTUs within an hour of the tap.

Assuming a duration of 1/2 hour, the *z* score for this initial high turbidity event would be 6 (at 830 mg/l SSC), indicating the possibility of moderate physiological stress for salmonids present below the dam during the tunnel tap.

The mean daily turbidities over the 5-day period (February 23-27) following the tunnel tap averaged 13 NTUs. The *z* score computed for this period was also 6 (at 13 mg/l SSC), indicating the possibility of moderate physiological stress to salmonids located near the dam throughout the 5-day period following the tunnel tap.

Over the 59-day period (April 1 – June 6) when mean daily turbidities exceeded 30 NTUs, the average turbidity was 76 NTUs (48 mg/l SSC). Mean daily turbidities averaged 99 NTUs (60 mg/l SSC) over the 33-day period of highest turbidity. The *Z* score for both of these turbidity events was 8, indicating the possibility of effects such as major physiological stress and reduction in feeding rate. No mortalities, however, ($z \geq 10$) were indicated.

ODFW examined the health of wild fish collected from the McKenzie River between Armitage Park and Harvest Lane on May 20, approximately one week prior to completion of Cougar Reservoir drawdown. Of those fish examined, juvenile trout 4-6 inches in length appeared to be healthy and in good condition. Adult rainbow trout appeared gaunt, but within the normal range of condition for this post-spawning period. Cutthroat trout ranging 6-12 inches in length were in very good to excellent condition. These fish spawn earlier in the year and would have had more time to recover from spawning period stresses. Fifty-three subyearling spring chinook salmon were examined and found to be in good condition. Other resident fish species examined (i.e., largescale sucker, redside shiner, and northern pikeminnow) also appeared to be in good condition (ODFW Apr-Jun 2002 Quarterly Report).

Sub-samples of adult rainbow and cutthroat trout and 6 juvenile trout were examined more closely by ODFW fish pathologists. These examinations corroborated the results of the above field observations. Stomach content analysis indicated that most fish had been feeding normally (ODFW Apr-Jun 2002 Quarterly Report).

ODFW pathologists also examined juvenile spring chinook salmon, whitefish, and rainbow trout captured on May 21 in a trap fished in the upstream end of the Cougar residual pool. Both rainbow trout and whitefish appeared healthy. The juvenile spring chinook had swollen tips on their gill filaments and clouded eyes. These condition factors may have resulted from trapping and handling stress as water temperatures near the trapping site were relatively high (ODFW Apr-Jun 2002 Quarterly Report).

As expected and discussed in the BA, some bull trout and other fish species were stranded in areas of the drawdown zone during drawdown. Attempts were made to salvage bull trout and other species (i.e., rainbow trout, juvenile spring chinook salmon, dace, cottids, whitefish, lamprey, and crayfish) where possible. Difficulty with access and operating logistics, warm water temperatures, and high turbidity hampered rescue efforts. Fish were in poor condition upon release into the residual pool. Some bull trout mortalities resulted (ODFW Apr-Jun 2002 Quarterly Report). Biological monitoring to date has not revealed any other impacts to bull trout.

The Corps worked with ODFW to identify and modify key areas in the drawdown zone where fish were stranded during drawdown. As a result, stranding of fish in these areas during subsequent drawdown events should be avoided. Monitoring during drawdown will be continued.

8.0 EFFECTS OF PROJECT ACTIVITIES NOT PREVIOUSLY EVALUATED

8.1 Turbidity (Water Quality). The impact of turbidity on water quality was mainly related to esthetics. The turbid water below the project during April through May was unusual for this time of year, at least for the last 40 years since the project was built, and was esthetically displeasing. Contaminants analysis revealed that no water quality criteria were violated for any contaminant of concern, including metals, PAHs, oganochlorinated pesticides, chlorinated herbicides, and organophosphorus pesticides. Oxygen, temperature, pH and conductivity levels were within normal limits. Particles in the water contributing to the turbidity were mostly clay-sized that remain in suspension for a long time.

Drawdown of Cougar Reservoir below its normal minimum pool level of 1,532 feet to the construction pool level of 1,400 feet resulted in substantial erosion of unvegetated soil surrounding the pool. The major tributary drainage streams flowing into the reservoir, the South Fork McKenzie, East Fork McKenzie, and Walker Creek, re-established channels to the lower pool at the 1,400 foot level. These processes transported large amounts of sediment into the newly created lower pool area at 1,400 feet. Detention time in the construction pool was sufficient to allow the bulk of the coarser grained sediment mass to settle out. Much of the fine-grained sediment mass (silt-clay fraction, grain size smaller then 62 microns) was released from the reservoir during the period from April 1 to May 25, 2002 when the pool level reached 1,400 feet. The fine-grained material released from the reservoir caused extended elevated turbidity in the South Fork McKenzie to the confluence and into the mainstem McKenzie Rivers. Visual observation of the South Fork McKenzie River gravel bed below Cougar Reservoir and of the mainstem McKenzie River below its confluence with the South Fork indicated the presence of a thin layer of silty material following the sustained releases of highly turbid water from Cougar Reservoir. This material did not accumulate on the surface of the gravel bed but was flushed through the system during subsequent high flows. In addition, some of the fine sediment in suspension accumulated in the algae covering the gravel bed, changing the color of the algae from green to gray.

Starting in November 2002, the operating plan for Cougar was to hold reservoir pool elevations within a target range of 1,400 to 1,410 feet. This is a different scenario than occurred during the Spring 2002 drawdown when the starting elevation was 1,532 feet and the reservoir was drawn down to 1,400 feet. As winter storms bring increased flows into the reservoir, the pool elevations will fluctuate and the pool will fill to levels above 1,410. The pool will then be drawn down at a rate not to exceed 6 feet per day.

Many factors may influence the turbidity levels of the discharge from the reservoir. Turbidity levels in the inflows from the tributaries entering Cougar reservoir may possibly reach as high as 400 NTU's. The resulting turbidity from these turbid inflows will be diluted in the lower reservoir pool, and passed on downstream. If a density current forms, then the dilution effect of the lower pool will be reduced and this highly turbid flow would be released from the reservoir. Utilizing the higher drawdown rate of 6 feet per day will clear the turbid water from the reservoir and downstream more quickly. Highly turbid flows from the tributaries entering Cougar reservoir are relatively rare and very short in duration. Median observed turbidity from the South Fork McKenzie above Cougar was 0 to 11 NTU range from November 2000 to January 2003.

The most likely source of turbidity will be from local erosion within the reservoir during rapid fluctuations in the pool levels during storm events throughout the winter and early spring. Operation of the reservoir throughout this period will expose erodable material in the reservoir below the normal flood control level of 1,532 feet to deposition into the fluctuating reservoir pool. As the pool level rises, discharges from Cougar could raise turbidity levels below the dam up to 350 NTU for brief periods. The rise in turbidity will be sharp, and the decline will be more gradual as the pool level is brought down to 1,400 feet. A turbidity level of 202 NTUs was recorded on December 31, 2002. As the winter progresses and storms cycle through, the peak turbidity levels should decrease as the erodable material in the lower pool is reduced by the pool fluctuations. The drawdown rate of 6 feet per day will help to clear the reservoir of turbid water faster than the drawdown rate of 3 feet per day did in Spring 2002.

Spring storms could still result in increased turbidity below the dam but the turbidity will be of shorter duration.

In 2003, it was proposed that the reservoir elevation be held as close to 1,400 feet as possible, and that a reservoir drawdown rate of 6 feet per day be used to accomplish and maintain this. The impact of this operation on turbidity during late spring storm events will depend on pool elevation. If the pool is successfully maintained at elevation 1,400 feet, turbidity will be higher because there is less volume to dilute the suspended sediment, but the turbid water will clear more quickly because of a reduced retention time. If the lake elevation is higher, the turbidity may be less but clearing of the pool will take longer. The drawdown rate of 6 feet per day will help to clear the reservoir of turbid water faster than the drawdown rate of 3 feet per day did in 2002.

The Corps has maintained the residual pool at (or close to) 1,400 feet since May 2002. A December rainstorm increased incoming flows and turbidity, resulting in the pool rising to 1,411 feet, and releases of turbidity up to 200 NTUs on December 30. Incoming turbidity in the South Fork reached 24 NTUs late on December 29, thus the downstream turbidity was about a 10-fold increase, as originally predicted. Turbidity at Hayden Bridge rose to 24 NTUs during that storm. (Average for December was 3.72 NTUs at Hayden Bridge.) (EWEB, pers. comm. Jan. 2003) The Corps was able to draw the reservoir back to 1,400 feet by January 1, 2003. Another rain event elevated the pool to 1,413 on January 5; however turbidity remained below 120 NTUs and dropped below 10 NTUs by January 8. Turbidity in January had not exceeded 120 NTUs, and generally has been between 55 NTUs and 3 NTUs (as of January 22, 2003).

With the January 30, 2003, storm event and the failure of the Rush Creek outlet, turbidity levels were high. Raising the pool to 1,450 feet reduced slope erosion at Rush Creek. Turbidity dropped to 2 NTUs by March, and have remained low during the Spring fishing season for 2003, with the pool maintained at 1,450 feet. Thus the Corps expects that turbidity in the Spring 2004 also will be greatly reduced from the 2002 levels. (See Section 2.3 of the SIR.)

During the operation in winter of 2003, the Corps was considering that sediment transport out of the reservoir be studied through two types of sampling. First, sampling at the USGS gage located downstream of the dam should be conducted to determine the suspended sediment concentration associated with different levels of turbidity. Second, sediment traps should be placed downstream of Cougar Dam to determine how much sediment settles out from turbid water leaving the reservoir. Sediment trap studies could not be conducted this year. They are still under consideration for 2004, subject to the availability of funding.

8.2 DDT in Sediment. Total DDT was exposed in cutbank areas within the reservoir, which eroded into the post-drawdown 1,400 foot pool, but was not measurable downstream of the dam. Total DDT levels detected within the 1,400 foot pool were 4.8, 6.2, 1.1, ND @ less than 0.6, and 25.9 ug/kg (ppb). Further erosion will occur within the pool, but will likely be less than the original drawdown event and will therefore not create further risk downstream. The sediments within the reservoir will be further redistributed with upcoming winter and spring events. Monitoring after the final deposition and distribution within the reservoir would be warranted to determine if natural attenuation will sufficiently isolate the Σ DDT from potential uptake by benthic organisms.

Four of five sediment samples collected within the reservoir did not detected Σ DDT above levels of concern. Sediment will continue to be deposited onto the reservoir bottom. The current area, within the reservoir, where Σ DDT exceeds reference levels of concern is limited and will likely change with future deposits and should be continually monitored, as should, the area below the dam.

No Σ DDT, at MDLs, was detected in sediment samples collected below Cougar Reservoir. A no effect determination has been made for this area.

Because of concerns regarding sediment transport out of the reservoir and the potential for export of DDT, additional monitoring will be considered to address these concerns. The nature of the material contributing to the turbidity, which reduced light penetration in the water, which may have impacted the aquatic community will be discussed in the section on fisheries and macroinvertebrates.

8.3 Spawning Gravel. Results of core samples taken of the spawning gravels in the South Fork McKenzie River below Cougar Reservoir and in the mainstem McKenzie River showed higher accumulation of fine sediments in the samples in the South Fork McKenzie than was present in the samples from the mainstem McKenzie River. Further analysis of the mainstem McKenzie River samples did not find clear evidence of Cougar Reservoir sediments based on the clay mineralogy (Stewart et al., 2002). These results suggest that relatively little of the sediment discharge from Cougar reservoir settled in any one location in the mainstem McKenzie, though as discussed above, a fine dusting of deposited material was evidenced. The analysis by Stewart et al. (2002) also cannot ascertain when sediments were deposited below Cougar Dam. They may have accumulated over the 40 year time period in which the reservoir has been in place.

While accumulation of fine sediment has occurred below Cougar Dam over an unknown time period, the high turbidity events during Spring 2002 were unlikely to have had long-term negative impacts on spawning gravel quality below Cougar Dam. However, assessment will be made of the rate of fine sediment accumulation in gravel areas during future storm events over the winter of 2002-2003 to aid in better understanding the dynamics of fine sediment transport and deposition, and its effects on habitat.

8.4 Macroinvertebrates. The abundance of organisms, species diversity, and presence of species sensitive to high levels of turbidity that were found in aquatic macroinvertebrate samples collected from areas located downstream of Cougar Dam indicated that this area was not heavily impacted by the relatively high turbidity events of spring 2002. Analysis indicated that the macroinvertebrate community below the dam was degraded in comparison to the community located above the reservoir. However, this is not unusual for areas located below dams, and this trend was also indicated in samples collected during 2000 and 2001 prior to drawdown of Cougar Reservoir (Figure 5). Indexes of biotic and habitat integrity (Wisseman 1996) ranged from moderate to low integrity for sampling stations located downstream of Cougar Dam.

8.5 Fisheries. The high turbidity events of spring 2002 had only minor, transient, impacts on fishes directly and relatively little effect on their habitat. Application of a scoring system developed by Newcombe and Jensen (1996) for relating magnitude (i.e., concentrations) and duration of suspended sediment events to effects on salmonids resulted in scores (z) ranging from 6 to 8 for levels of turbidity occurring directly below Cougar Dam. These scores indicate that impacts to salmonids in the South Fork McKenzie River resulting from the high turbidity events of spring 2002 may have ranged from moderate physiological stress ($z=6$) to major physiological stress and reduction in feeding rate ($z=8$) during the period of high turbidities.

However, assessments of condition for multiple fish species sampled both from below Cougar Dam and from within the residual pool above the dam by ODFW biologists and pathologists failed to detect health-related problems and documented that most fishes sampled were actively feeding and in good condition.

8.6 Aquatic Vegetation. There have been anecdotal reports of increased plant growth in the mainstem McKenzie since construction began at Cougar Dam in 2001. A combination of decreased light, increased turbidity, possibly increased nutrients such as phosphorus and organic carbon, and different water temperatures may have increased plant growth in the mainstem McKenzie. Or, the increased plant growth may have been a normal between years variation. Once construction of the temperature control structure is over, conditions should return to as before except for one environmental variable - temperature. Temperature in the South Fork will return to pre-dam conditions.

For the past 39 years, since the dam was built, the South Fork and the mainstem McKenzie Rivers, probably as far as Vida have not been "natural" in terms of historic conditions that fish and human residents experienced. In other words, the river as now experienced, is not the normal, natural, pristine river. The purpose of the construction project is to return the South Fork and mainstem to more natural conditions. The aquatic organisms that now inhabit the rivers are adapted to current conditions. Some changes in aquatic communities that reflect the restored natural conditions can be expected.

8.7 <u>Socio/Economic</u>. The 2002 Cougar drawdown had a negative effect on trout fly-fishing on the McKenzie River that was not anticipated or evaluated in the FR/EIS. On April 1, the Corps started drawing down Cougar Reservoir in order to install a multi-level intake tower, which would release water into the river at temperatures appropriate for threatened species of fish. That sent accumulations of clay into the river and turned it a brownish-gray color. This caused turbidity levels to spike more than anticipated. Then, on May 26, the Corps stopped drawing down the reservoir. According to the *Springfield News*, by June 12 the turbidity had dropped back to normal levels.. The *Springfield News* also noted that one of the fishing guides reported staying away from the river from April 14 until June 5. The guide indicated that while the McKenzie was not back to its typical clarity by that time, the fishing was good and the river was getting near record runs of steelhead and salmon.

The turbidity problem affected fishing guides, lodges, motels, gas stations, restaurants, and small grocery stores, according to the Convention and Visitors Association of Lane County (CVALCO). CVALCO, the McKenzie River Chamber of Commerce, and the river guides association mailed out a survey to lodge owners and other local business owners. It was called “Cougar Reservoir Draw-Down Economic Impact Survey” and included questions about type of business, comparative gross revenues from 1999 to 2002 (or, change in gross revenues), customer counts (1999 to 2002), and cancellations or other declines in business attributable to turbidity of the McKenzie River or other Cougar Reservoir draw-down-related factors.

A news release from the McKenzie River Chamber of Commerce and the Convention and Visitors Association of Lane County summarized the results of the survey, as follows. “During March, April and May, area businesses reported 301 cancellations, resulting in lost revenues of $88,656. Most of the losses were reported by river guides, with $15,000 to $16,000 of lost revenue reported by lodging, retail and other business owners. Customer counts dropped by 445, from 1,723. Guide-related revenues were down $48,712 compared to the same time last year. Other survey respondents noted that poor river conditions resulted in a lower call volume with fewer bookings. A total of 27 businesses responded to the survey reflecting only a partial sampling of the overall impacts.”

The survey is in no way used as a projection. Neither is it a claim to have captured total area economic losses. As CVALCO noted in their press release, “A total of 27 businesses responded to the survey reflecting only a partial sampling of the overall impacts.” In a February 14, 2003, comment letter on the draft Supplemental Information Report, CVALCO also noted that “Reporting was not uniform (some surveys were partially blank). Some responses lacked financial data and indicated only that they were having to abandon their business, or included estimates of lost customers but not related financial impacts. CVALCO was very careful to stipulate in its release of data that results were based on a small response and not representative of total economic losses."

These comments regarding the survey reveal some of the inherent difficulties found in gathering specific information on economic or financial impacts, whether using various survey instruments or direct contacts. Not everyone is willing to provide such information. The survey simply presents a summary of the information provided by the 27 businesses who did respond to the survey.

To help put economic impacts in a local context for the reader, some illustrations of claimed losses from a June 7, 2002, letter from the attorney for the President, McKenzie River Guides Association are included here.

"1. Income for some of the resorts is down for the March to May months is down $10,000 to $20,000.

2. McKenzie River Guides Association members have had clients cancel over one hundred fishing days with clients.

3. A Walterville store which usually sells 200 fishing licenses by the end of May, as well as selling associated bait, tackle and other fishing supplies, has only sold about ten licenses to date.

These examples indicate that the recent, prolonged sediment pollution on the mainstem of the McKenzie has led to socio-economic impacts unforeseen in the original EIS or the Supplemental EA."

Locals indicate that these impacts have been difficult, particularly for smaller businesses that are very dependent on the summer tourism season. Some of the businesses operate near capacity for a relatively short season, and don't have the capacity to make up for early losses later in the season. There is local concern that if the same impact recurs over the next few years, there will be more lasting damage to the local tourism economy.

Congressman DeFazio has sponsored legislation for some compensation for losses in the Water Resources Development Act legislation. If that occurs, the incentive of compensation may result in more than 27 respondents submitting claims of economic impact, thereby increasing the $88,656 figure for lost revenues.

8.8 <u>EWEB</u>. Eugene Water and Electric Board manages the municipal water supply for Eugene. The intake for the water supply plant withdraws from the McKenzie River near Hayden Bridge, 49 miles downstream from Cougar Dam. EWEB tested for several water quality parameters related to construction at Cougar Project. During the drawdown, turbidity fluctuated between 2 and 26 NTUs. The average turbidity recorded at Hayden Bridge during the 2 month period (April and May) was 10.3 NTUs compared to 2.6 NTUs for the same time period in 2001. Based on treatment plant criteria, additional chlorine was used when the river water exceeded 3.0 NTUs. The additional turbidity needed a slightly higher alum dosage (about 2 mg/l), additional lime for pH adjustment and substantially more backwash water (with corollary return to the river) during the drawdown. Subsequent to the drawdown period, EWEB tested sludge for presence of DDT and found neither DDT nor any breakdown products. EWEB did have concerns that, should turbidity exceed 3.0 NTUs during high demand summer months, they would not have the capacity to do extra filtration to meet that demand. Additional chemical usage and filtration, an increase in power and staffing was required during the Spring. These additional treatments added extra costs to the usual treatment costs. The Corps agreed to hold Blue River Reservoir full and release additional flow late in the summer season to dilute turbidity in the McKenzie. This action was not necessary in 2002.

9.0 ENVIRONMENTAL EVALUATIONS AND COORDINATION

9.1 Evaluation/Mitigation. The situation regarding turbidity and sediment has been evaluated as described above. While turbidity during the 2002 drawdown exceeded predictions in the mainstem McKenzie River, levels were not unusual for historic late winter-early spring flood events. The drawdown did occur later in the Spring than predicted, making turbidity more noticeable and interfering with the trout fly-fishing season. The Corps stopped the drawdown at 1,400 feet elevation, instead of continuing to lower the pool to 1,375 as originally proposed, and the water cleared to less than 15 NTUs by June 15.

This situation can be mitigated during the remaining 2 years of construction by operating the reservoir at 1,400 (now 1,450) foot elevation year-round to the extent possible. Levels exceeding 1,400 (1,450) feet will be drawn down at the rate of 6 feet/day instead of the previous 3 feet/day. This should allow the reservoir to be at 1,400 (1,450) feet by March 1, and returned to 1,400 (1,450) feet more quickly if there is a major Spring storm. Turbidity will continue to be monitored during construction years.

Levels of DDT above concern were not found below Cougar Reservoir. Monitoring will continue during construction years.

Deposition of fines and insect occurrence were evaluated during the summer/fall of 2002. More fine sediments were found in cores samples from the South Fork McKenzie than in the mainstem McKenzie, but there is no way to know when the fines were deposited. Insect occurrence below the dam is different than above the dam; however, this is typical for below and above dams. Insects populations were varied and numerous below the dam.

Assessment of fisheries below the dam indicated only minor, transient impacts to fishes and little effect on their habitat.

Income losses in 2002 due to reduction of trout fly-fishing and associated expenditures were evaluated by the Convention and Visitors Association of Lane County (CVALCO). Legislative action may provide some mitigation for these losses.

Actions by EWEB due to turbidity in municipal water supply intake have been described. Additional filtering was required during the Spring, but not during Summer months. Water is available from Blue River Reservoir to dilute turbidity in summer months should this become a problem.

Actions at the ODFW fish hatchery at Leaburg included adding additional chemicals to treat the fish.

9.2 Significance. Effects of turbidity in the South Fork of the McKenzie and the McKenzie mainstem during construction drawdown of 2002 were primarily local and esthetic. There are no indications that fish or aquatic invertebrates were adversely affected. Fishing later in the season was quite good (Stahlberg, 2002.) Fall spawning in the South Fork noticeably increased in 2002 due to river water approaching pre-dam levels, a strong indicator that the purpose of the temperature control project will be achieved. Total spring chinook redds below Cougar Dam increased from 61 in 2001 to 108 in 2002. This increase occurred below USFS Road 19, about 2.4 miles below the dam; above the bridge there was a decrease in redds from 44 in 2001 to 24 in 2002. This was a good year for spring chinook, thus all of the increase is not necessarily due to the restoration of normal stream temperatures (ODFW, pers. comm. 2003).

There was an unexpected financial impact on the local economy. Interference with spring trout fly-fishing was not anticipated. According to CVALCO, local residents and businesses reported losses totaling about $88,656. While this may have caused temporary hardship for local residents, it is not regionally or nationally significant, given that the 2002 Oregon Employment Department Regional Economic Profile indicates that the Eugene MSA (Lane County) had a 2000 population of 323,950 people, with a per capita income of $25,584, resulting in total income of approximately $8.3 billion dollars in the regional area. Springfield is the nearest city for which the Oregon Employment Department 2002 Regional Economic Profile provides statistics on population. It had a 2000 population of 52,864. (Neither the Oregon Employment Department or the Portland State University Population Research Center provide information on smaller communities such as Walterville, Leaburg, Vida, Blue River, and McKenzie Bridge.) The U.S. Census Bureau, Census 2000, shows 1999 per capita income of $15,616. Using the local Springfield population of 52,864 people, with a 1999 per capita income of $15,616, results in a total income of approximately $825.5 million in the Springfield area. Recognizing that the losses actually reported may not capture the total economic losses that resulted from the Cougar drawdown, even a substantial increase in losses would not be regionally significant, or in the more local context of Springfield. It is recognized that there were unanticipated disruptions to individuals in local communities, and those affected have concerns about economic impacts to their businesses. Recompense is a possibility via legislative action. The local and regional economy also benefited from construction related expenditures, although no estimate of that benefit is available. With changes in operation of Cougar Reservoir during the remaining construction years, interference with trout fly-fishing season and subsequent economic loss is not expected to re-occur or be as pronounced as in 2002. Heavy spring storms, however, could still result in turbid conditions. In fact, a winter storm resulted in high turbidity and flows. By holding the pool at 1,450 feet, turbidity below Cougar was back to 6 NTUs by the March trout season. While low NTUs during the entire fishing season cannot be assured, the Corps has taken and will continue to take all available measures and practices to reduce disruption during the 2 remaining years of construction.

9.3 Coordination. Throughout the pre-construction and construction process, the Corps has coordinated with Federal and State resources agencies, local governments, interest groups and the public. Since publication of the Feasibility Report/EIS in 1995, the Corps has coordinated the project with the ECC as described above. The Corps also held public meetings on May 22, 2002, and February 12, 2003, and has maintained an information website.

This Supplemental Information Report and accompanying EA amendment has been coordinated with Federal and State resources agencies, local governments, interest groups and the public. These draft documents were distributed for 30-day review, beginning January 30, 2003. During the review process, operation of Cougar Reservoir continued as described in this SIR. The ECC has been notified of the necessity of continuation of interim actions during the review and preparation of final documents.

9.4 Review Comments and Responses. The Corps received six written comments on the EA/SIR as a result of the meeting, mailing and internet posting. Comments were received from the National Marine Fisheries Service (NMFS), the McKenzie Watershed Council Water Quality Monitoring Committee (MWWQC), Eugene Water and Electric Board (EWEB), William C. Carpenter Jr., Kari Westlund (CVALCO),and David Rodriguez. Comments are summarized and responded to in the attached EA amendment. Changes have been incorporated into this final document.

10.0 FINDINGS AND RECOMMENDATIONS

10.1 Findings. The reservoir drawdown was scheduled to start in January 2002 but did not occur until April. Turbidity which would have been less noticeable in February and March, when turbid flood flows are typical, was highly noticeable and esthetically displeasing in April and May. The flow of turbid water from Cougar Lake occurred during the trout fly-fishing season, resulting in economic loss to local residents. This situation did not reoccur in 2003.

The amount of turbidity below Cougar Dam during drawdown was not known prior to construction. Estimates in the FR/EIS and FDM No. 21 acknowledged uncertainty; estimates ranged from 10-fold increase above stable reservoir levels of 0.6 to 2.9 NTUs to 600 NTUs, which occurred when Fall Creek Reservoir was drawn down in 1989. Estimates of sediment moved and redeposited, as given in the FDM, are probably higher than what actually occurred and will occur over the next 2 years; however, the relationship of silty sediments to downstream turbidity was not adequately communicated.

Water quality, including turbidity, has been analyzed since construction began in 2000. Other than turbidity, water released from Cougar Reservoir during construction has not exceeded State standards. It was acknowledged that turbidity probably would exceed State standards; notification and coordination with Oregon Department of Environmental Quality occurred as required.

During construction monitoring of sediments, DDT and its derivatives were discovered in sediments in the pool drawdown zone. This probably results from forest spraying prior to construction of Cougar Dam. DDT was exposed in four cutbank areas tested within the reservoir, which exceeded established levels of concern for the protection of the aquatic environment. One of five samples collected in the post-drawdown 1,400 foot residual pool, exceeded established levels of concern, but was not detectable downstream of the dam. Even

with re-distribution of sediments within the reservoir due to drawdown, there is no indication that DDT above levels of concern have been or likely will be carried into the river system. Levels of concern to humans were not exceeded in any of the samples tested.
Sampling of macroinvertebrates below Cougar Dam, in both the South Fork McKenzie and McKenzie mainstem shows no appreciable change in quantities of insects from above the reservoir. Changes in species differ above and below the reservoir; however, that is normal for such areas.

Turbidity in the South Fork and mainstem McKenzie during trout fly-fishing season resulted in loss of fishing opportunities. The CVALCO survey resulted in a partial response of 27 respondents who reported $88,656 in lost income. If more people had responded to the survey, that figure for lost revenues might have been higher. EWEB had to temporarily increase filtration, chemical treatment and staff, and ODFW had to increase antibiotic treatment of hatchery fish.

Due to the failure of the Rush Creek outlet on January 30, 2003, turbidity increased temporarily. To avoid continued slope erosion at the outlet, the pool was raised to elevation 1,450. The project has continued to operate at elevation 1,450, drawing the pool down at the 6 feet/day rate whenever inflow causes the pool to rise above 1,450. Erosion of the outlet slope does not compromise dam safety and no immediate repairs are planned. The Corps will continue to monitor and assess this situation.

10.2 Recommendations.

Based on the above information and additional technical documentation in the appended material, it is recommended that the following modifications be adopted:

Reservoir operation will keep the pool at 1,450 foot elevation year-round as much as possible. Flood control operations will be maintained, with the pool drawn down to elevation 1,450 at the rate of 6 feet/day below the normal flood control pool of 1,532 feet. Blue River Reservoir will be operated normally, as described above.

Monitoring for water quality and sediments, including DDT, will continue.

Biological monitoring above and below Cougar Dam will continue. Monitoring of spring chinook fry emergence from redds located below Cougar Dam will be added to currently ongoing monitoring tasks. If turbidity below Cougar Dam exceeds 30 NTUs for more than 10 days, a fish sampling protocol will be implemented to document any changes in fish condition that may occur. (This protocol was implemented after discussions with NMFS and with others on the Environmental Coordination Committee subsequent to the January 30, 2003, storm and failure.)

The Corps of Engineers is not currently authorized to compensate for losses to individuals. However, if legislation is passed to provide compensation, the Corps will implement the legislation to compensate for economic losses.

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APPENDIX A

COUGAR RESERVOIR
WATER QUALITY
MONITORING PROGRAM

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WATER QUALITY DURING CONSTRUCTION OF THE SELECTIVE WITHDRAWAL STRUCTURE AT COUGAR RESERVOIR

Introduction. Congress approved construction of a Selective Withdrawal Structure (SWS) at Cougar Reservoir to improve downstream temperatures in the South Fork McKenzie and mainstem Mckenzie for the benefit of fish. Construction of the SWS will involve adding three sliding weir gates to the current withdrawal structure that will allow water of different temperatures at depth to be released from the reservoir. But, before construction could begin, the reservoir needed to be drawn down to elevation 1400'so that workers could have access to the tower. This was accomplished by tapping the tunnel connecting the bottom of the reservoir with the river below the dam. The tunnel tap and the subsequent drawdown to elevation 1400'could impact water quality in release waters sent downstream and in the reservoir itself. A plan for monitoring water quality during construction of the SWS was developed in consultation with the Resource Agency Advisory Team that was set up by the Corps. The monitoring plan, results from monitoring, and unanticipated water quality impacts of the drawdown as well as plans for dealing with these impacts are presented in this Appendix.

Water quality monitoring plan. In consultation with the resource agencies, the Corps developed a water quality monitoring program to cover the year before construction, the three years of construction, and one year of post construction. The program involves monitoring water quality above, in and below the reservoir. The Corps contracted with the United States Geological Survey (USGS) to establish monitoring gages upstream (gage 14159200) and downstream (gage 14159500) of the reservoir on the South Fork McKenzie. The upstream gages measure water discharge, temperature and turbidity; the downstream gage measures water discharge, temperature, turbidity, dissolved oxygen (DO) and DO percent saturation. These gages have been in place since November and December of 2000 and operate continuously, reporting measured parameters as an average over every half-hour. USGS maintains a website with the data from these gages at http://oregon.usgs.gov/mckenzie/monitors. The data is considered provisional by the USGS until it is quality assured. The USGS data for the monitoring period, though referred to in this appendix , is not included as a table in the appendix but can be viewed by querying the USGS web site.

The Corps contracted with the USFS, Blue River Ranger District, to monitor water quality in the reservoir before and during construction of the SWS. The Forest Service collects data from April through November at three sites on the lake – near the withdrawal tunnel, the East Fork arm and the South Fork arm. In 2000 the reservoir was sampled monthly and in 2002 bimonthly. A Hydrolab instrument is used to profile the reservoir from surface to bottom at the three sites. Parameters measured are depth, temperature, dissolved oxygen, dissolved oxygen percent saturation, pH, specific conductivity and turbidity.

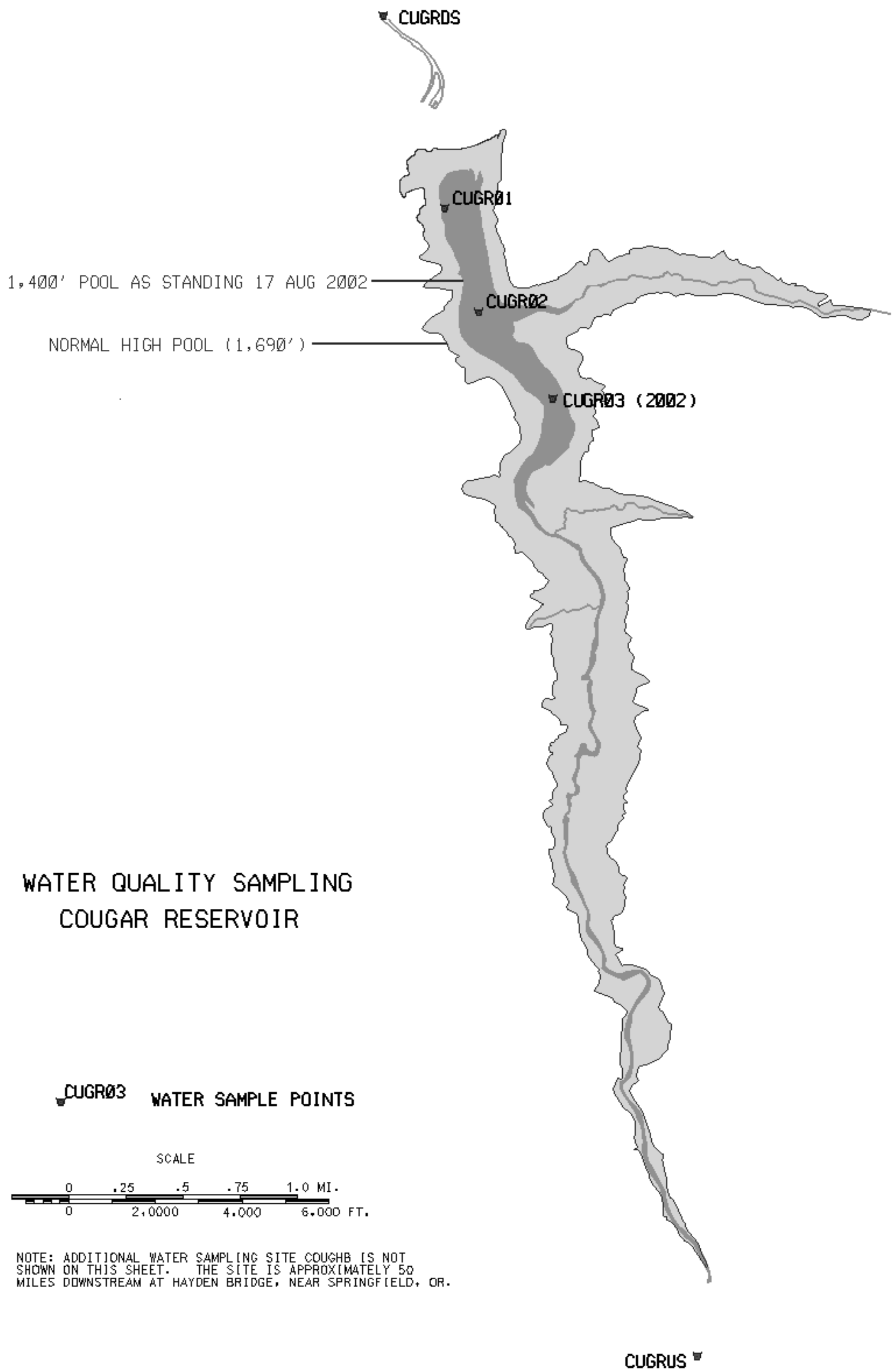
The USFS also collected data at three sites below the dam during the tunnel tap on February 23, 2002. The sites were at the bridge on the South Fork below the project on forest Route 19 about 2 miles below the dam, at Forest Glen 3 miles below the confluence of the mainstem Mckenzie and the South Fork, and at the bridge at Finn Rock 10.5 miles below the dam and 6 miles downstream of the confluence with the mainstem Mckenzie. This data complements that collected by the USGS using a YSI monitor at the gage station 0.6 miles downstream of the dam. The USGS measured temperature, pH, turbidity, specific conductance, dissolved oxygen, and percent dissolved oxygen saturation with the YSI monitor as well as the data collected by the gage equipment – discharge, turbidity, DO, % DO saturation, and temperature. Both the USFS and USGS data are shown in Table A.

To assess whether the turbid water from drawdown contained contaminants associated with sediment, the Corps contracted with the USFS to collects samples for analysis. The locations of the sampling sites are shown in Figure 1 and site descriptions in the Table below. During drawdown of the reservoir to construction pool elevation, the USFS collected water grab samples for chemical analysis from the South Fork at the gage sites above and below the reservoir (1 and 4 samples respectively), and in the mainstem McKenzie at Hayden Bridge (3 samples). The samples were collected on three dates – May 15, June 3, and June 17, 2002. These were sent off to Severn Trent Laboratories (STL) for analysis of contaminants including 17 metals, 18 polynuclear aromatic hydrocarbons (PAHs), 26 organophosphorus pesticides, 12 chlorinated herbicides, 20 organochlorine pesticides, 5 anions, total organic carbon (TOC), biological oxygen demand (BOD), color, conductivity, cyanide, fecal coliforms, hardness, total dissolved solids (TDS), and turbidity (Table B).

To assess the physical nature of the turbid water and the potential for siltation downstream of the dam, the Corps asked the USFS to collect water samples at the above sites for analysis of Total Suspended Solids (TSS) and grain size distribution. Analyses of the samples were carried out by the USGS Volcano Observatory Lab in Vancouver, Washington. Samples were collected according to the schedule below:

Sample #	**Site Description**	**Date/time**	**Turbidity**
CUGRUS	gage 14159200 US of res	5/15/02 1400	0.5
CUGRDS1	gage 14159500 DS of dam	4/24/02 0745	32.0
CUGRDS1d	gage 14159500 DS of dam	4/24/02 0925	31.8
CUGRDS2	gage 14159500 DS of dam	5/2/02 1500	95.8
CUGRDS3	gage 14159500 DS of dam	5/15/02 1510	86.0
CUGRDS4	gage 14159500 DS of dam	6/3/02 0825	42.0
CUGRHB	M. R. at Hayden Br	5/15/02 1745	-
CUGRHB2	M. R. at Hayden Br	6/3/02 0645	-

Figure 1.

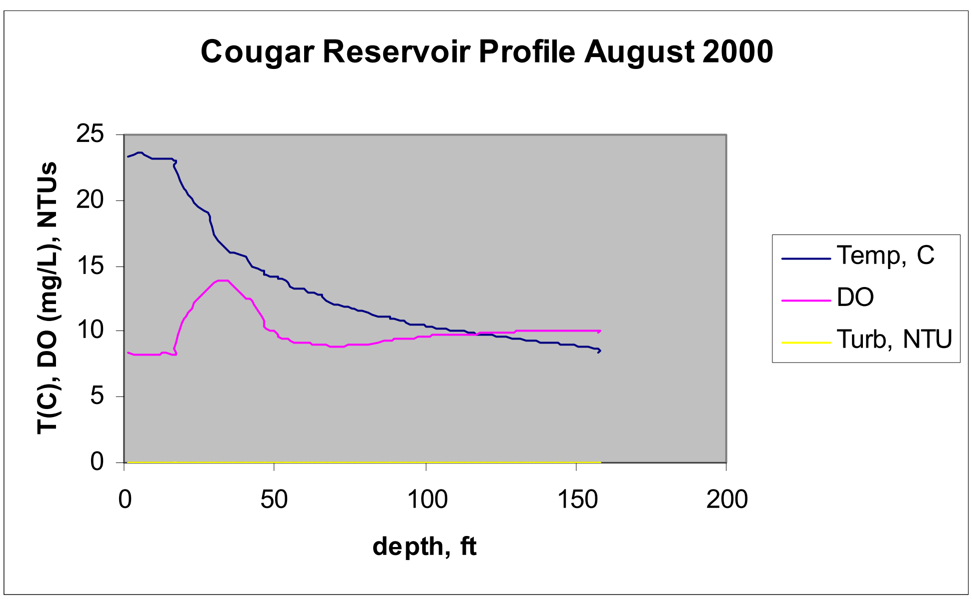

CUGRDS
CUGRØ1
1,400' POOL AS STANDING 17 AUG 2002
CUGRØ2
NORMAL HIGH POOL (1,690')
CUGRØ3 (2002)
WATER QUALITY SAMPLING
COUGAR RESERVOIR
CUGRØ3 WATER SAMPLE POINTS
SCALE
0 .25 .5 .75 1.0 MI.
0 2,0000 4,000 6,000 FT.
NOTE: ADDITIONAL WATER SAMPLING SITE COUGHB IS NOT SHOWN ON THIS SHEET. THE SITE IS APPROXIMATELY 50 MILES DOWNSTREAM AT HAYDEN BRIDGE, NEAR SPRINGFIELD, OR.
CUGRUS

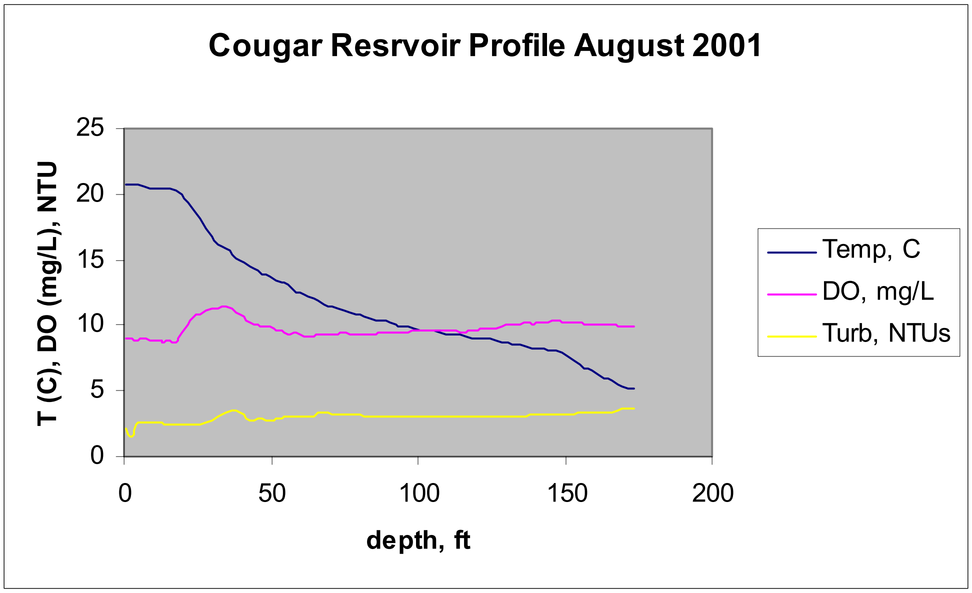
During August an algae bloom developed in the reservoir. This is an annual event but because of the smaller size of the pool and the visual appearance of the bloom the Corps had the USFS collect water samples for species identification and cell density determinations. These analyses were performed by Mr. Jim Sweet of Aquatic Analysts.

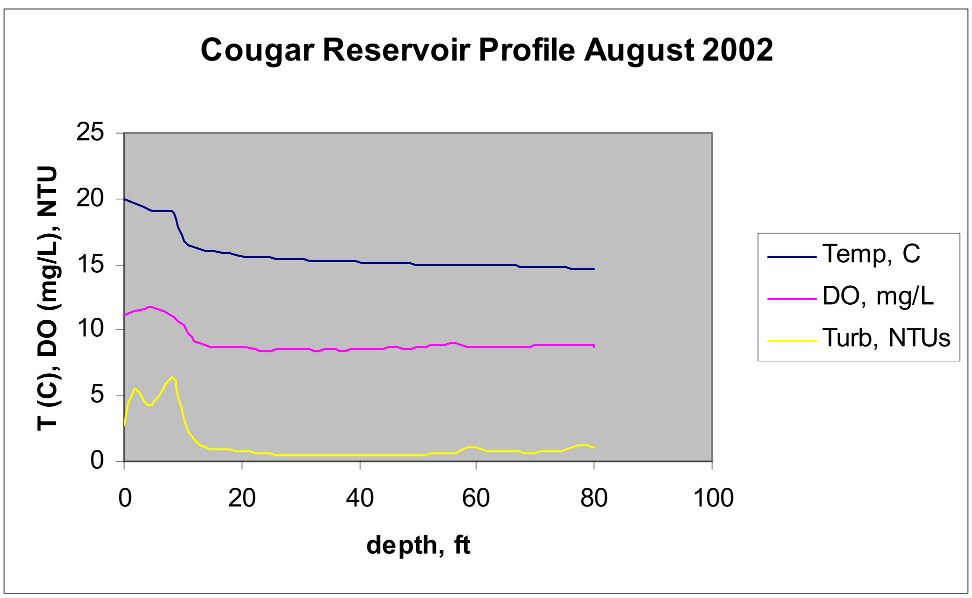
Summary of water quality Monitoring results.

Pre-drawdown water quality. The monitoring data from year 2001 and 2002, before construction began, showed that water quality in the reservoir and in the South Fork above and below the reservoir is excellent . At the upstream site, water temperatures did not exceed 60 degrees F and turbidity was usually less than 5 NTUs with a spike up to 119 and 324 NTUs during a storm events. At the below dam site water temperatures never exceeded 60 degrees, turbidity rarely exceeded 50 NTUs and usually was below 10 NTUs, and daily minimum oxygen ranged between 7.4 and 11.6 mg/L. In the reservoir in August, during the warmest period in the reservoir, oxygen ranged from 8 to 15 mg/L, temperatures varied from 73 degrees F at the surface to 47 at the withdrawal outlet (see Figures 2-4 below). These data support conclusions from earlier studies that indicate that Cougar Reservoir is somewhere between mesotrophic and oligotrophic and that the South Fork McKenzie river has excellent water quality (USACE, 1996, 2000 and Atlas of Oregon Lakes, 1985).

FIGURES 2-4



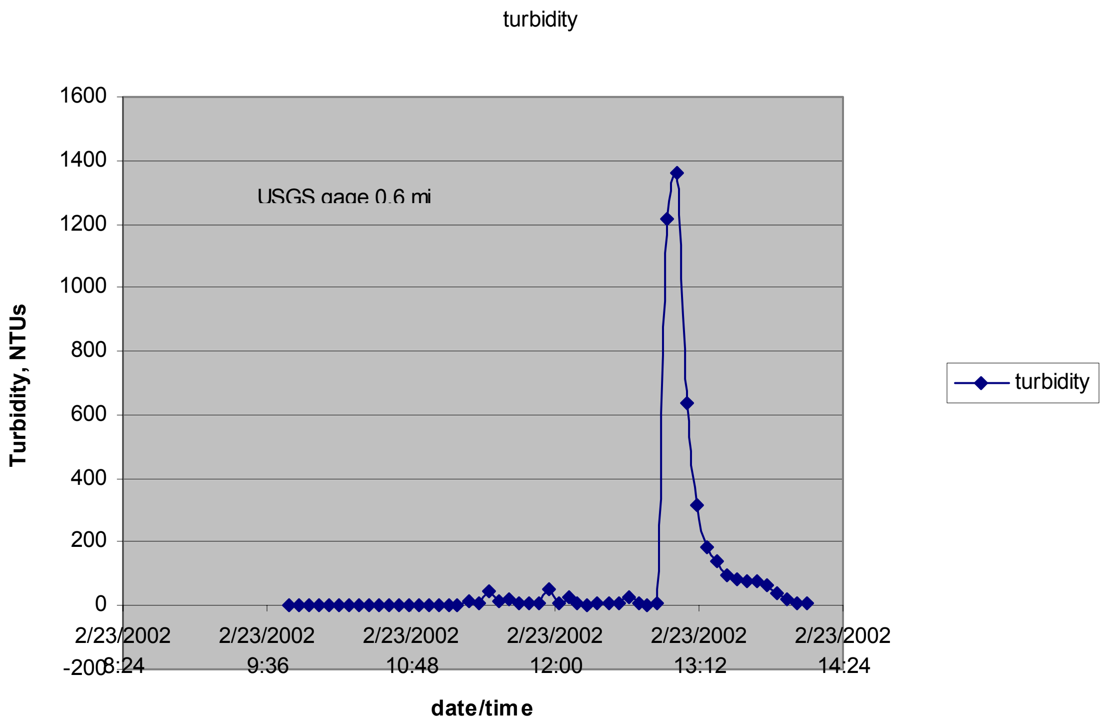




Tunnel tap water quality. During the tunnel tap of February 23 data was collected at the gage (USGS #14159500) downstream of the dam and by the USFS sites on the the South Fork below the dam and at Forest Glenn and Finn Rock in the mainstem McKenzie (Table A).

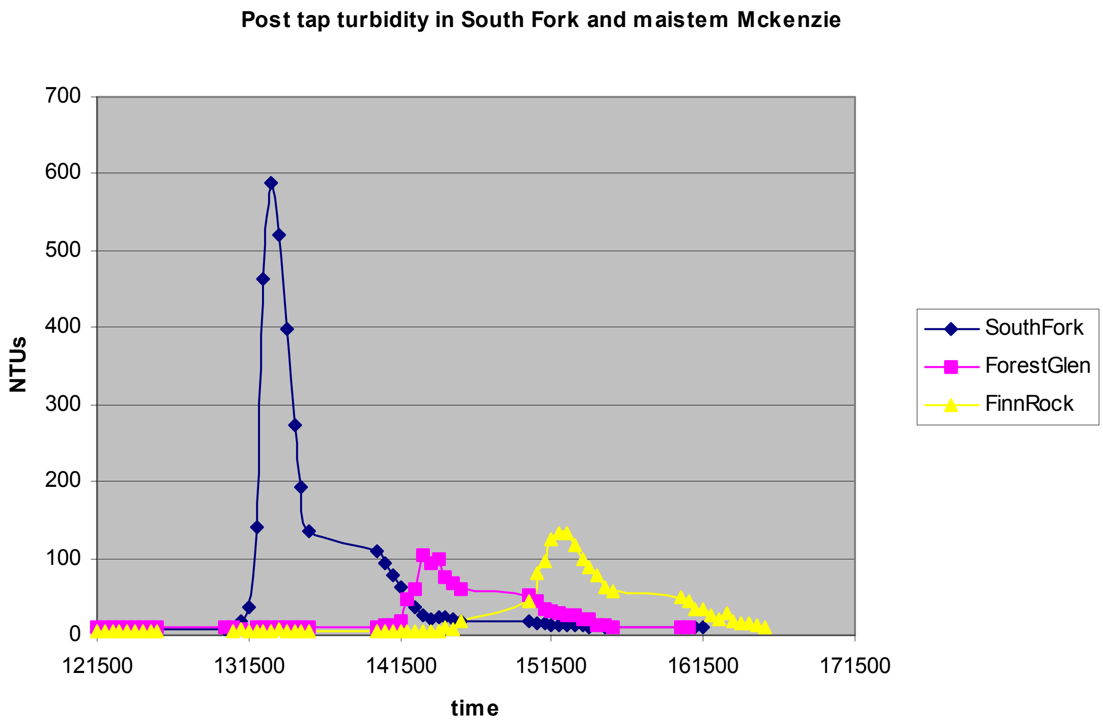
Figure 5 below shows the peak turbidity achieved immediately downstream of the dam – about 1358 NTUs. Within an hour turbidity was back to that observed before the tunnel tap, around 8 NTUs.

Figure 5.



The peak turbidity at the bridge below the dam was 588 NTUs, 104 NTUs at Forest Glen, and 133 NTUs at FinnRock (Figure 6 below). It took the turbidity plume about 3 hours to travel 10.5 miles. The reason turbidity at Forest Glen was lower than Finn Rock was because the turbidity plume hugged the south shore of the mainstem Mckenzie and was not fully mixed by the time water reached Forest Glen.

Figure 6.



The effect of the tunnel tap on other water quality parameters was slight. For instance, pH increased from 7.2 to 8.5, specific conductance from 36 to 52, while dissolved oxygen dropped from 13.2 to 12.8 mg/l and percent dissolved oxygen saturation from 108.5 to 104.3. All parameters were back to pre-tunnel tap values within an hour.

Drawdown water quality

Turbidity. Because of tunnel construction delays, drawdown of the pool was delayed and began on April 1st continuing to May 26th of 2002. The results of turbidity monitoring below the dam at the gage station are shown in the Figure 7 below. At the gage downstream of the dam turbidity ranged from 1 to 379 NTUs. Median turbidity levels were 98 NTUs with the high of 379 NTUs occurring on the 28th of April.

A factor that exacerbated the turbidity coming out of the dam was a storm event in the watershed above the project that caused inflows to increase up to 5,800 cfs on the 14th of April (Figure 8). This inflowing water was highly turbid and ran up to 327 NTUs at 05:00 AM. At this time turbidity below the dam was 48.4 NTUs. Beginning mid morning of the 14th turbidity started to rise below the dam. At about 23:00 hours of the 14th turbidity increased to 135 NTUs. There was an 18 hour spread between the peak turbidity at the gage upstream of the reservoir and the peak turbidity downstream of the reservoir. After that, turbidity below the dam gradually dropped to around 30 NTUs eleven days later on the 25th of April. If no dam had been in place, we could have expected turbity levels to have achieved 300 plus NTUs in the mainstem Mckenzie where the South Fork enters it. Over the last 40 years one of the impacts of the dam has been to dampen these springtime (or any other) turbidity events that occurred. Likely, the turbidity from these events cleared fairly quickly from the system, whereas, with the dam in place, turbidity is dampened and spread over a longer time period.

Beginning around the 28th of April turbidity below the project began to rise again as the lowering of the pool, following the earlier storm event, caused inflows to continue eroding the sediment wedge in the upper end of the reservoir (Figure 7). From the 28th of May on, when construction pool elevation of 1400 feet was reached, turbidity declined rapidly as inflowing water diluted the turbidity in the reservoir.

Figure 7.

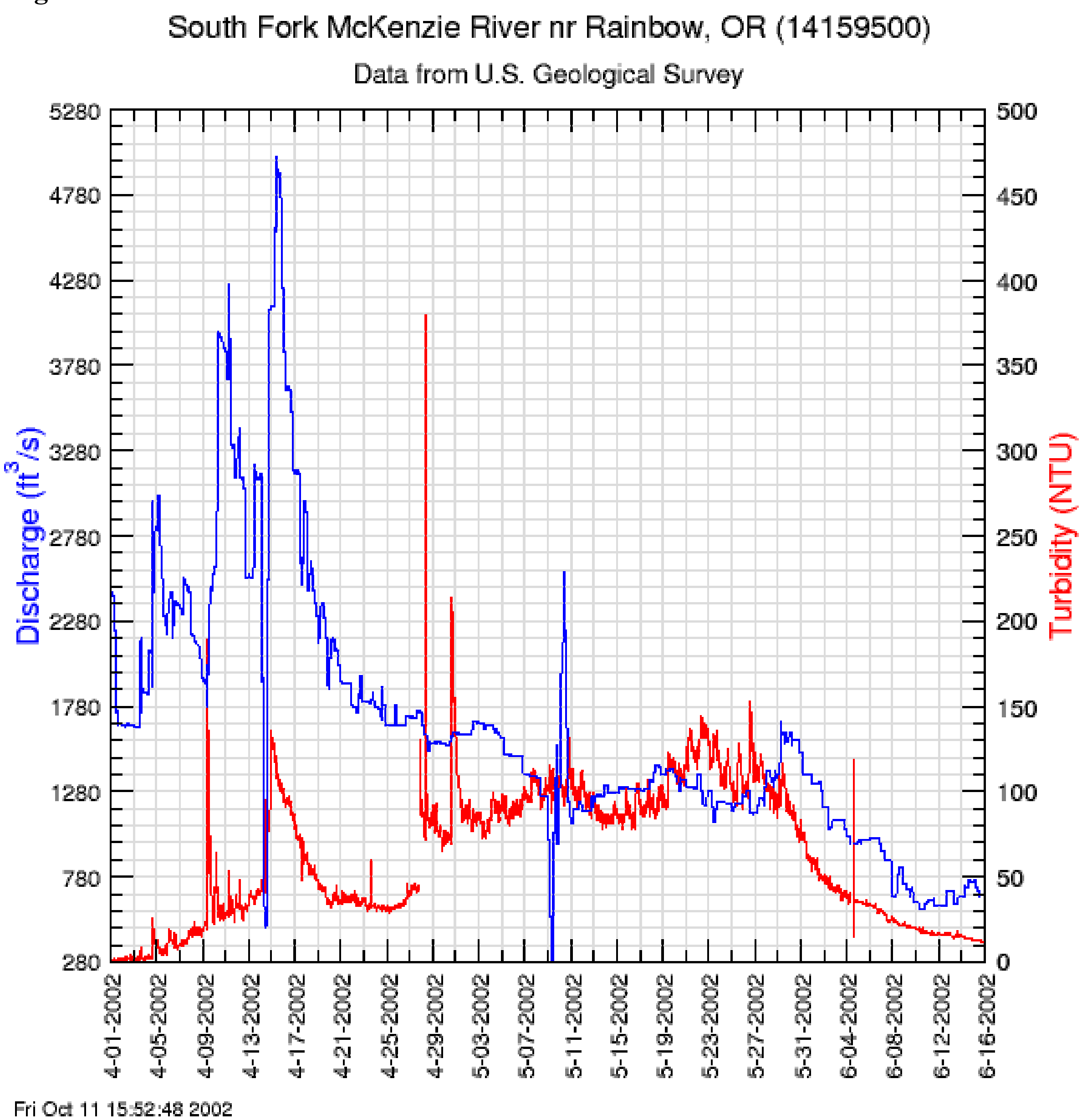
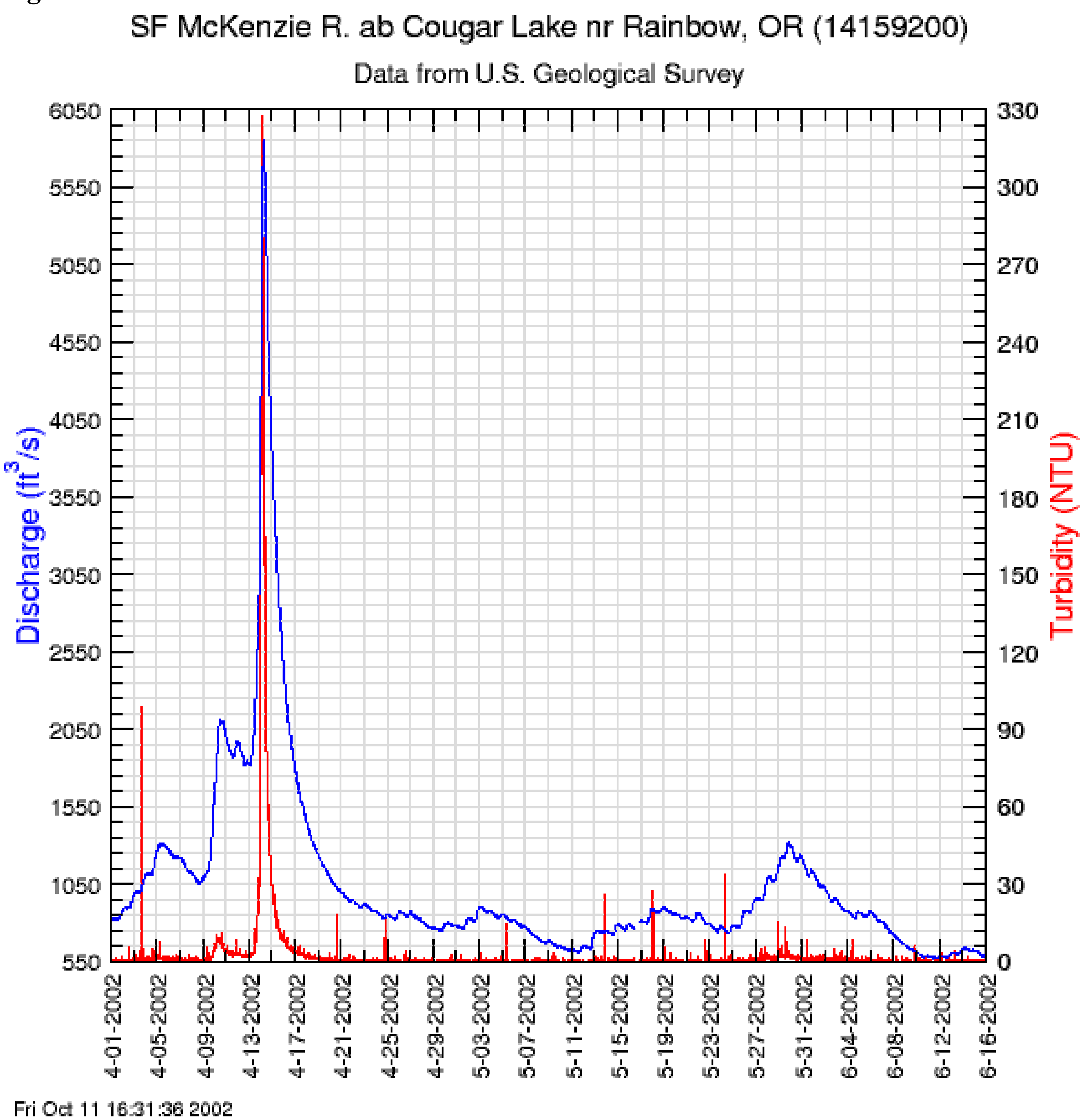


Figure 8.



For the duration of drawdown high turbidity was observed in the South Fork below the dam and in the mainstem Mckenzie at least as far as Hayden Bridge near Springfield. This prolonged turbidity raised questions regarding impacts to the environment. For instance, did the turbid water contain contaminants, such as DDT, since there was evidence of DDT in reservoir sediment, that could be exported from the reservoir? Was there an increase in sediment deposition downstream that was detrimental to aquatic life including fish habitat? Later in this appendix additional studies are proposed that will help provide information to address these impacts.

The Corps had addressed turbidity in the Cougar Feasibility Report and EIS, which stated that turbidity levels in outflows could exceed 100 NTUs (Corps, 1995, FR p90 and A-39 and EIS pg 3-13, 4-16) and by inference 200 to 600 NTUs (FR, p89, 4th par and p90 2nd par.) and that turbidity would be an "unavoidable adverse impact" (EIS, p4-47). It was estimated that the turbidity would not impact the mainstem Mckenzie because the mainstem would dilute turbid waters (EIS, p4-17). This is in fact what happened during drawdown. The South Fork Mckenzie contributes, roughly, 20 % of the mainstem McKenzie flow. Thus, the average turbidity downstream was diluted from about 100 NTUs below the dam to 11 NTUs at Hayden Bridge (EWEB, personal communication) 49 miles downstream.

In the EIS the estimated impact to the mainstem was based on drawdown occurring in late winter, when naturally high turbidity would normally occur because of storm events. Unfortunately, because of construction delays, drawdown did not occur until spring, which impacted the fishing industry along the river and raised questions regarding effects on fish habitat and potential export of contaminants in turbid water.

Predicting turbidity levels during 2003 drawdown will be difficult because the situation will be different. In 2002 the starting elevation of drawdown was 1532' while in 2003 it will be 1400' elevation. So, in 2002, there was a greater volume of water to dilute the suspended sediment that caused turbidity. On the other hand in 2003 there will be less of a sediment wedge in the upper end of the reservoir to erode. During the 2002 drawdown maximum turbidity reached 379 NTUs but the median turbidity was about 83.9 NTUs. The turbidity was less than 100 NTUs 76 percent of the time.

What can we expect for the drawdown of 2003? There are two experiences that may bracket what to expect. The first involves the Corps' experience with the drawdown of Fall Creek Reservoir in 1989. As Fall Creek was drained sheet movement of water across the exposed sediment wedges and downcutting of the old channel bed increased turbity. As the lake approached its bottom turbidity was about 100 NTUs. When the original channel was reclaimed tubidity went up over 600 NTUs. It's not unreasonable to assume similar processes to occur at the upper end of Cougar Reservoir during times when the reservoir will increase in elevation from winter storm runoff then decrease in elevation as water is removed in order to maintain the 1400' elevation goal. The first time this "bath tub filling then partially draining" scenario is played out, the reservoir will have a volume of water in which the turbid water from the upper end will be diluted. But, if the reservoir is already turbid and another episode of filling occurs, the situation may get worse in terms of turbidity. Unlike the Fall Creek situation turbidity in outflow waters should be much less than 600 NTUs because of dilution by reservoir water. It's possible that a density flow of cold, turbid water could short circuit through the reservoir and pass through the tunnel. In that case turbidity might be higher but not for a sustained period. The second experience involves the 2002 drawdown at Cougar. Peak turbidity was 379 with a median of 83.9 NTUs. Probably, turbidity will be similar to what we observed in 2002 but it could go higher because the dilution of turbidity in the reservoir will be impacted by the starting reservoir elevations. In 2002 the starting elevation was 1532’ which provides more dilution volume than the staring elevation of 2003 (1400’). However, there are a couple of factors that could contribute to less turbidity in 2003. First, the 2002 drawdown has already moved some sediment from the upper end of the reservoir to the lower end where it won’t be exposed to erosion. Second, the old channel of the South Fork has re-established and armored itself, which should cut down on bank undercutting except at high inflows. So, considering all these factors, it seems reasonable to conclude that turbidity during drawdown of winter of 2003 will be similar to 2002, possibly higher, but probably not exceeding the 600 NTUs experienced at Fall Creek.

The impact of springtime storm events on turbidity will follow a similar pattern to winter storm events. In the Spring of 2003 it is proposed that reservoir elevation be held as close to 1400’ as possible. The impact of this operation on turbidity during late spring storm events will depend on pool elevation and the turbidity of incoming water. If the pool is at 1400’ turbidity will increase during a storm event because, as the reservoir is drained of stormwater to get back down to 1400 foot elevation, erosion of the upper sediment wedge will contribute to turbidity. The volume of the lake will help dilute and reduce this turbidity. The proposed 6’ per day drawdown rate in 2003 will clear the reservoir of turbid water faster than the 3’ per day drawdown rate of 2002.

Conventionals. During drawdown median DO in the South Fork McKenzie was 11.33 mg/L and median %DO saturation was 98.8 %. Neither violated state standards. Maximum temperature achieved was 49.6 degrees F.

The figure below presents the data collected by the USFS during August of 2000, 2001, and 2002 for comparison of pre-drawdown reservoir conditions to that of the construction pool post-drawdown.

Contaminants. As stated earlier, samples were taken of the water coming into the reservoir and of the turbid drawdown water for analysis of metals, PAHs, organophosphorus pesticides, chlorinated herbicides, organochlorine pesticides, conventionals, Total Suspended Solids (TSS), and grain size distribution (see Table B). No contaminants were detected above established DEQ or EPA concern levels in any sample. The Table below summarizes results of pesticides analysis. In one drawdown sample, CUGRDS1, taken at the gage below the dam when turbidity was 86 NTUs, 0.454 ug/L of diazinon and 0.155 ug/L of malathion were detected but not in a duplicate sample from the same site. A trace of DDT was detected in this sample at 0.000599 ug/L, which was also not confirmed in the duplicate sample. This is below the EPA freshwater acute (1.1 ug/L) and chronic (0.001 ug/L) water quality criteria for DDT. The organochlorinated pesticide beta-BHC was detected at 0.000562 ug/L in a sample taken of inflow water to the reservoir. This was also well below the acute water quality criterium of 100 ug/L for BHC. It appears from this limited data set that contaminants, in the form of metals and organics, such as DDT, were not exported from the reservoir during drawdown. During periods of high turbidity in the future drawdow of 2003, an expanded effort will be made to determine if DDT is exported from the reservoir.

Concentrations of pesticides in water samples taken above and below Cougar Reservoir during drawdown.

Site	date	turbidity# (ntu)	diazonon ug/L	malation ug/L	DDT ug/L	beta-BHC ug/L	others* ug/L
S.F.upstream of reservoir							
CUGRUS	5/15/2002	0.5	-	-	0.000562		-
S.F.downstream of dam (about 1 kilometer)							
CUGRDS1	5/15/2002	86.4	0.454	0.155	-	0.000599	-
CUGRDS2 dup	5/15/2002	86.2					-
CUGRDS4	6/3/2002	42.2	-	-	-	-	-
CUGRDS5	6/17/2002	26.2	-	-	-	-	-
M.R.at Hayden Bridge Springfield							
CUGRHB	5/15/2002	11.4	-	-	-	-	-
CUGRHB2	6/3/2002	6	-	-	-	-	-
CUGRHB3	6/17/2002	2.2	-	-	-	-	-

turbidity taken from contemporaneous USGS and EWEB readings in river at time of sampling

***** others: 24 organophosphorus pesticides, 12 chlorinated herbicides, 18 organchlorine pesticides

- a dash means not detected, method detection limits varied as follows:

organophosphorus pesticides	0.00263 to 0.164	ug/L
chlorinated herbicides	0.0068 to 0.0356	ug/L
organochlorine pesticides	0.000109 to 0.0119	ug/L

Sediment characteristics. Despite the appearance of turbid water coming from the reservoir during drawdown, there was little evidence of extensive sediment transport out of the reservoir. The table below shows characteristics of sediment in drawdown water samples. Sediment in the drawdown samples was very fine-grained and of low concentration (21 to 60 mg/L). Ninety nine percent of the material in the water, was finer than the 62 micron grain size that separates silt from sand. Most of the sediment in the water was in the clay sized fraction (<4.0 microns). It was difficult to get enough sediment out of a sample for grain size distribution analysis. A sample taken on the 15th of May, 2002 at the gage downstream from the dam, when turbidity was at 86 NTUs, revealed that 98 % of the sediment was smaller than 62 microns and 74 % of that was in the clay size – 4 microns or smaller (31 % was smaller than 1 micron).

Grain size characteristics of sediment in drawdown outflow water samples taken below Cougar dam and at Hayden Bridge in the mainstem McKenzie

sample location	date	time	gage NTU	mg/L	sediment total	sediment sand mg/L	sediment fines	% finer than 62 microns
USGS gage above reservoir (CUGRUS)								
	5/15/2002	14:00	0.5	1.0	1.0	0.4	0.6	59
USGS gage below reservoir (CUGRDS)								
	4/24/2002	7:45	32.0	60.0	60.4	0.6	59.9	99
	4/24/2002	9:25	31.8	21.0	21.1	0.4	20.7	98
	5/8/2002	15:00	96.8	85.0	85.3	2.2	83.0	97
	5/15/2002	15:10	86.4	39.0	38.6	0.5	38.0	99
	6/3/2002	8:25	42.2	26.0	25.8	0.2	25.6	99
Hayden Bridge (CUGRHB)								
	5/15/2002	17:45	11.4	12.0	11.7	0.1	11.7	100
	6/3/2002	6:45	6.0	8.0	8.1	0.7	7.4	92

Phytoplankton. Typically, a bloom of blue-green algae occurs in Cougar Reservoir in August. This again happened in August of 2002. A total of 18 species were identified in the algae bloom. The bloom was dominated by the blue-green species *Anabaena flos-aquae* and *Anabaena circinalis*. Cell densities for *flos*-aquae varied from 9,160 cells/ml on August 7th to 139,066 cells/ml on August 19th (Table C).

Future Water Quality Monitoring. The USGS and USFS water quality monitoring plan described earlier in the Appendix will be followed in 2003 and 2004. Additiionaly, because of concerns about possible export of sediment and DDT from the project that might impact downstream habitat and water quality, the Corps will contract with the USGS to perform additional monitoring . The details are not worked out yet, but briefly, the plan is to establish suspended sediment-turbidity relationships in the South Fork Mckenzie above and below the project, in the mainstem McKenzie above where the South Fork enters, in the mainstem McKenzie at Vida, and in the Blue River below Blue

River Reservoir. The aim is to use the relationships predict, from turbidity measurements, suspended sediment export. Another plan is to measure DDT in water coming into the reservoir, leaving the reservoir, and in the mainstem Mckenzie above where the South Fork enters during storm event-high turbidity conditions to assess whether DDT is being exported from the reservoir. Finally, sediment traps may be set out to try to predict how much sediment is being deposited downstream of Cougar Reservoir in the South Fork and mainstem McKenzie River.

Conclusions. Water quality was monitored above and below the reservoir and in the reservoir prior to, during, and after the tunnel tap and drawdown. Water quality in the South Fork and reservoir prior to the beginning of construction was very good. Construction activities and drawdown impacted water quality by increasing turbidity to high levels (median 98 NTUs) below the dam. The turbid water below the project and in the mainstem McKenzie during April through May was unusual for this time of year, at least for the last 40 years since the project was built, and was aesthetically displeasing. Oxygen, temperature, pH and conductivity levels were within normal limits. Particles in the water contributing to the turbidity were mostly clay-sized that remain in suspension for a long time. There was probably little settling out of this material. Other water quality parameters of concern, such as metals and pesticides, were below established concern levels. The high downstream turbidity and detection of DDT is exposed reservoir sediment raised questions regarding the potential for export of sediment and DDT downstream of the project. Future studies will address these concerns.

Staring in November of 2002 the plan is to hold the reservoir at 1400' feet elevation as much as possible. This is a different scenario than occurred during the Spring of 2002 drawdown when the staring elevation was 1532' and the reservoir was drandown to 1400'. As winter storms bring increased flows into the reservoir it may be impossible to hold the reservoir at 1400'. Then, the reservoir will fill to some unknown elevation depending on conditions and would undergo a drawdown to 1400' elevation as storm water is released from the project. This could happen several times depending on the weather. Based on Corps experience at Fall Creek reservoir, we can expect up to 600 NTUs of turbidity to occur in the upper end of the reservoir where active cutting through new deposits, undercutting of the channel side slopes, or new channel formation occurs. Because of dilution by the volume of the reservoir turbidity will be much less – probably similar to that experienced in 2002. If a density current carries this turbidity to the tunnel outlet, we could see turbidity levels this higher than experienced in 2002, but probably not as high as 600 NTUs. In 2003 high turbidity will occur during the winter when storm events naturally increase turbidity in the McKenzie basin, not in the spring, except during unusual storm events, as occurred in 2002.

Ongoing water quality monitoring will be continued at the gage sites above and below the project and in the reservoir. This monitoring was detailed earlier in this Appendix. Because of concerns regarding impacts sediment transport out of the reservoir and the potential for export of DDT, additional water quality monitoring is proposed for 2003 that will provide information about outflow turbidity-suspended sediments relationships, deposition of sediment downstream, and export of DDT downstream. It is proposed that suspended sediments and DDT in a range turbid waters be measured and that sediment traps be set out to observe the extent to which settling of sediment occurs at downstream locations.

WATER QUALITY APPENDIX

TABLES

A. **USGS, USFS tunnel tap water quality data.**

B. **Contaminants data from water samples taken below the dam during drawdown in 2002.**

C. **Phytoplankton data from algae bloom in summer 2002.**

TABLE A

USGS tunnel tap data

Gage 14159500
SF Mckenzie River near Rainbow
Cougar Tunnel Tap on 2-2 Mar-02 at 12 45
YSI data

Date Time m/d/y hh:mm:ss	Temp C	SpCond uS/cm	DOsat %	DO mg/L	pH	Turbid NTU
2/23/2002 9:47	5.08	39	97.8	12.47	7.48	2.6
2/23/2002 9:52	5.08	39	97.9	12.48	7.49	2.6
2/23/2002 9:57	5.08	40	97.8	12.47	7.5	3.3
2/23/2002 10:02	5.08	40	97.8	12.46	7.49	1.8
2/23/2002 10:07	5.08	40	98	12.49	7.5	2.1
2/23/2002 10:12	5.1	40	97.9	12.47	7.49	1.8
2/23/2002 10:17	5.1	40	98.2	12.51	7.5	2.1
2/23/2002 10:22	5.09	40	97.9	12.47	7.49	1.8
2/23/2002 10:27	5.1	40	97.9	12.47	7.49	1.8
2/23/2002 10:32	5.08	40	98.1	12.5	7.5	2
2/23/2002 10:37	5.07	40	97.9	12.48	7.5	2.1
2/23/2002 10:42	5.08	40	97.8	12.47	7.5	2.2
2/23/2002 10:47	5.09	40	98	12.49	7.5	2.3
2/23/2002 10:52	5.09	40	97.9	12.48	7.48	1.7
2/23/2002 10:57	5.08	40	98.1	12.5	7.49	2
2/23/2002 11:02	5.07	40	98	12.49	7.49	1.8
2/23/2002 11:07	5.07	40	98	12.49	7.49	2
2/23/2002 11:10	5.14	40	101.7	12.95	7.5	1.8
2/23/2002 11:17	5.25	40	109.8	13.93	7.53	13.4
2/23/2002 11:22	5.25	39	109.1	13.84	7.54	6
2/23/2002 11:27	5.22	39	108.5	13.77	7.53	48.2
2/23/2002 11:32	5.19	39	108.7	13.81	7.53	16.6
2/23/2002 11:37	5.24	39	109.1	13.85	7.55	18.8
2/23/2002 11:42	5.24	39	108.7	13.8	7.55	8.2
2/23/2002 11:47	5.25	39	110	13.95	7.53	10.8
2/23/2002 11:52	5.23	39	109.1	13.85	7.53	6
2/23/2002 11:57	5.25	39	108.9	13.81	7.55	52.6
2/23/2002 12:02	5.25	39	109	13.83	7.55	7.1
2/23/2002 12:07	5.23	39	109.4	13.89	7.54	24.8
2/23/2002 12:10	5.22	39	108.7	13.8	7.54	5.1
2/23/2002 12:15	5.23	39	109	13.84	7.54	3.1
2/23/2002 12:20	5.23	39	109.4	13.89	7.54	6.4
2/23/2002 12:27	5.25	39	108.1	13.71	7.54	5
2/23/2002 12:32	5.26	39	109.2	13.85	7.54	7.6
2/23/2002 12:37	5.2	39	109.2	13.88	7.53	27.4
2/23/2002 12:42	5.22	39	109.3	13.88	7.54	7.4

2/23/2002 12:45	5.23	39	108.7	13.8	7.54	2.5
2/23/2002 12:50	5.25	39	109.3	13.87	7.55	8.3
2/23/2002 12:55	5.27	72	100.8	12.79	9.42	1214.9
2/23/2002 13:00	4.82	65	97.7	12.54	8.94	1358.1
2/23/2002 13:05	4.62	54	99.1	12.78	8.3	635.1
2/23/2002 13:10	4.55	49	99.5	12.85	7.83	315.7
2/23/2002 13:15	4.52	46	100.1	12.94	7.63	186.7
2/23/2002 13:20	4.51	45	100.5	13	7.54	142.3
2/23/2002 13:25	4.49	44	100.9	13.06	7.5	96.6
2/23/2002 13:30	4.47	44	100.9	13.07	7.46	83.5
2/23/2002 13:35	4.47	44	100.9	13.07	7.44	74.4
2/23/2002 13:40	4.46	44	101	13.08	7.43	75.4
2/23/2002 13:45	4.48	44	101.3	13.11	7.42	64.5
2/23/2002 13:50	4.64	43	103.2	13.3	7.42	41.8
2/23/2002 13:55	4.92	40	107.7	13.79	7.48	17.9
2/23/2002 14:00	5.05	39	110.2	14.06	7.48	8.6
2/23/2002 14:05	5.1	39	109.7	13.97	7.5	7.8

Log File Name : SouthFork USFS data
Comments: Probe in low velocity water along East shore, depth 1.6 feet.

Date MMDDYY	Time HHMMSS	Dep100 feet	Temp øC	DO% Sat	DO mg/l	Turb NTUs	pH Units	SpCond uS/cm
22302	91500	1.6	5.04	104.8	12.73	8.2	7.08	35.4
22302	92000	1.6	5.05	105.2	12.77	7.8	7.08	35.4
22302	92500	1.6	5.05	104.7	12.72	7.9	7.11	35.4
22302	93000	1.6	5.05	105.1	12.77	8	7.11	35.4
22302	93500	1.6	5.08	104.7	12.71	8.2	7.14	35.4
22302	94000	1.6	5.06	104.6	12.7	8.2	7.15	35.4
22302	94500	1.6	5.06	104.5	12.69	8.4	7.16	35.4
22302	95000	1.6	5.07	106.1	12.87	8.5	7.15	35.4
22302	95500	1.6	5.08	104.6	12.69	8.4	7.16	35.3
22302	100000	1.6	5.08	106	12.86	8.6	7.17	35.3
22302	100500	1.6	5.1	106.3	12.89	8.4	7.17	35.3
22302	101000	1.6	5.11	106.5	12.92	8.4	7.18	35.4
22302	101500	1.6	5.12	106.6	12.92	8.4	7.19	35.5
22302	102000	1.6	5.12	106.7	12.94	8.5	7.19	35.5
22302	102500	1.6	5.12	107.1	12.98	8.5	7.19	35.5
22302	103000	1.6	5.12	107.1	12.99	8.6	7.2	35.5
22302	103500	1.6	5.12	106.7	12.94	8.5	7.2	35.5
22302	104000	1.6	5.12	106.8	12.95	8.4	7.19	35.5
22302	104500	1.6	5.1	106.7	12.94	8.3	7.19	35.5
22302	105000	1.6	5.11	107.1	12.98	8.5	7.21	35.5
22302	105500	1.6	5.1	106.7	12.93	8.6	7.2	35.5
22302	110000	1.6	5.1	106.7	12.94	8.5	7.2	35.6
22302	110500	1.6	5.11	106.8	12.95	8.4	7.18	35.5
22302	111000	1.6	5.1	106.8	12.95	8.6	7.2	35.6
22302	111500	1.6	5.14	106.6	12.92	8.4	7.2	35.6
22302	112000	1.6	5.12	106.5	12.91	8.5	7.21	35.6

22302	112500	1.6	5.13	106.6	12.92	8.5	7.21	35.6
22302	113000	1.6	5.12	106.7	12.93	8.5	7.22	35.7
22302	113500	1.6	5.14	106.7	12.92	8.2	7.21	35.6
22302	114000	1.6	5.15	107.2	12.99	8.8	7.2	35.7
22302	114500	1.6	5.17	108.2	13.1	8.7	7.22	35.7
22302	115000	1.6	5.18	108.3	13.11	8.8	7.22	35.6
22302	115500	1.6	5.17	108.5	13.14	8.8	7.22	35.5
22302	120000	1.6	5.17	108.6	13.14	9	7.22	35.5
22302	120500	1.6	5.17	108.5	13.14	9.1	7.22	35.5
22302	121000	1.6	5.17	108.7	13.15	8.9	7.21	35.5
22302	121500	1.6	5.18	108.5	13.14	8.7	7.22	35.4
22302	122000	1.6	5.18	108.3	13.11	8.7	7.21	35.5
22302	122500	1.6	5.18	108.4	13.12	8.9	7.22	35.5
22302	123000	1.6	5.19	108.5	13.13	8.7	7.21	35.6
22302	123500	1.6	5.19	108.5	13.13	8.3	7.22	35.6
22302	124000	1.6	5.2	108.4	13.12	8.5	7.2	35.7
22302	124500	1.6	5.22	108.6	13.13	8.8	7.21	35.7
22302	125000	1.6	5.2	108.7	13.15	8.9	7.23	35.7
22302	125500	1.6	5.22	108.4	13.11	8.6	7.22	35.7
22302	130000	2	5.21	108.7	13.15	8.8	7.22	35.7
22302	130500	2	5.18	109.3	13.23	9.1	7.22	35.6
22302	131000	2.6	5.21	109.5	13.24	17.8	7.22	35.5
22302	131500	2.6	5.21	108.6	13.14	35.6	7.38	36.5
22302	132000	2.3	5.22	107.5	13.01	141	8.07	41.1
22302	132500	2	5.16	106	12.84	463	8.57	49.4
22302	133000	2	5.07	105.1	12.75	588	8.54	52.2
22302	133500	2	4.9	104.4	12.73	521	8.29	51.1
22302	134000	2	4.78	104.3	12.75	399	7.96	48.7
22302	134500	2	4.65	104.2	12.79	274	7.65	46.2
22302	135000	2	4.58	104.3	12.82	192	7.49	43.9
22302	135500	2	4.51	104.4	12.86	136	7.4	42.6
22302	140000	2	4.49	104.9	12.93	108	7.36	41.7
22302	140500	2	4.46	104.7	12.92	92.6	7.32	41
22302	141000	1.6	4.51	104.4	12.85	78.9	7.31	40.3
22302	141500	1.6	4.62	104.9	12.89	62	7.28	39.4
22302	142000	1.6	4.73	105	12.86	46.8	7.27	38.5
22302	142500	1.6	4.84	106.1	12.96	36	7.25	37.4
22302	143000	1.6	4.92	106.8	13.01	26.3	7.23	36.4
22302	143500	1.6	4.97	107.1	13.03	22	7.24	36
22302	144000	1.6	4.99	106.7	12.98	23.1	7.24	36.4
22302	144500	1.6	5.01	106.1	12.9	24.2	7.26	36.6
22302	145000	1.6	5.07	106	12.87	21.5	7.27	36.6
22302	145500	1.6	5.1	106	12.86	19	7.28	36.6
22302	150000	1.6	5.13	105.7	12.81	17.1	7.29	36.6
22302	150500	1.6	5.13	105.5	12.78	15.8	7.3	36.5
22302	151000	1.6	5.15	105.4	12.76	14.4	7.28	36.5
22302	151500	1.6	5.14	105.4	12.77	13.4	7.26	36.5
22302	152000	2	5.12	104.9	12.72	13.1	7.25	36.5
22302	152500	1.6	5.11	105.9	12.84	12.9	7.24	36.5
22302	153000	1.6	5.1	105	12.74	12.3	7.24	36.5

22302	153500	1.6	5.07	105.2	12.77	12	7.25	36.6
22302	154000	1.6	5.06	105	12.75	11.6	7.24	36.5
22302	154500	2	5.06	105.2	12.77	11.8	7.24	36.5
22302	155000	1.6	5.06	105.7	12.84	11.6	7.24	36.4
22302	155500	1.6	5.05	105.3	12.78	11.2	7.23	36.4
22302	160000	1.6	5.03	105.2	12.78	11.4	7.24	36.4
22302	160500	1.6	5.04	104.9	12.74	11.5	7.23	36.3
22302	161000	2	5.04	105	12.76	11.1	7.22	36.4
22302	161500	1.6	5.04	105	12.75	11.2	7.21	36.3
22302	162000							
22302	162500							
22302	163000							
22302	163500							
22302	164000							
22302	164500							
22302	165000							
22302	165500							

Recovery finished at 022302 164231
Recovery finished at 022302 164659

Log File Name : ForestGlen USFS data
Comments: Probe in low velocity water along North shore, depth 0.7 feet.

Time	Temp	DO%	DO	Turb	pH	SpCond
HHMMSS	øC	Sat	mg/l	NTUs	Units	uS/cm
91500						
92000						
92500						
93000						
93500						
94000						
94500						
95000						
95500						
100000						
100500						
101000						
101500	5.46	94.2	11.89	10.9	6.34	37.7
102000	5.47	91.3	11.51	12.6	6.57	37.7
102500	5.48	90	11.35	12.3	6.67	37.8
103000	5.49	90.3	11.39	10.7	6.76	37.7
103500	5.49	90.1	11.36	10.9	6.83	37.7
104000	5.5	89	11.22	10.8	6.87	37.7
104500	5.51	89.5	11.28	10.2	6.9	37.7
105000	5.51	89.7	11.3	10.4	6.94	37.7
105500	5.51	89.5	11.27	10.7	6.98	37.7
110000	5.52	88.8	11.19	11	6.97	37.6
110500	5.53	90.1	11.34	10.6	7.03	37.6
111000	5.53	89.8	11.3	9.2	7.05	37.6

111500	5.54	90	11.33	9.9	7.06	37.6
112000	5.55	90.3	11.37	11.7	7.09	37.5
112500	5.56	90.3	11.36	10.4	7.08	37.6
113000	5.57	89.2	11.22	10.5	7.11	37.6
113500	5.58	89.4	11.25	10.2	7.09	37.6
114000	5.58	89.3	11.26	10.6	7.13	37.6
114500	5.58	88.9	11.18	10.1	7.16	37.6
115000	5.59	89.3	11.22	9.6	7.17	37.6
115500	5.6	89.7	11.27	10.9	7.18	37.6
120000	5.6	89.6	11.27	9.9	7.18	37.5
120500	5.61	89.9	11.3	10.9	7.2	37.5
121000	5.62	89.6	11.26	8	7.19	37.5
121500	5.64	89.1	11.19	11.4	7.2	37.6
122000	5.66	89.1	11.18	10.5	7.22	37.5
122500	5.67	89.1	11.18	10	7.22	37.5
123000	5.69	89.7	11.24	10.4	7.21	37.6
123500	5.7	89.2	11.19	9.6	7.24	37.5
124000	5.69	89.7	11.24	10.6	7.24	37.5
124500	5.7	89.7	11.24	9.8	7.25	37.5
125000	5.71	89.7	11.25	10.5	7.25	37.5
125500	5.73	89.1	11.16	10.7	7.25	37.5
130000	5.75	90.3	11.3	10.4	7.26	37.5
130500	5.76	89.6	11.22	10.1	7.27	37.5
131000	5.79	89.8	11.24	6.7	7.26	37.5
131500	5.82	89.4	11.18	4.4	7.27	37.5
132000	5.82	89.6	11.2	10	7.26	37.5
132500	5.82	89.3	11.17	9.8	7.29	37.5
133000	5.82	89.9	11.24	10.1	7.28	37.5
133500	5.83	89.4	11.17	10.4	7.29	37.5
134000	5.83	90	11.25	10.1	7.28	37.5
134500	5.83	90	11.24	9.5	7.26	37.5
135000	5.82	90.4	11.3	9.9	7.29	37.5
135500	5.83	90.6	11.32	10.3	7.28	37.4
140000	5.82	90.8	11.34	11.2	7.26	37.5
140500	5.81	91	11.37	12.4	7.29	37.4
141000	5.81	90.5	11.32	12.1	7.31	37.4
141500	5.8	90.7	11.34	19.2	7.33	38
142000	5.8	89.7	11.22	46.6	7.38	39.6
142500	5.8	88.9	11.12	60.6	7.53	41.3
143000	5.79	88.4	11.06	104	7.65	42.6
143500	5.76	89.5	11.2	94	7.68	43.3
144000	5.73	88.9	11.13	99	7.66	43.2
144500	5.69	87.8	11.01	75.6	7.61	42.7
145000	5.65	89	11.17	67.1	7.57	41.9
145500	5.62	88	11.05	58.9	7.52	41.2
150000	5.62	88.4	11.1	51.8	7.49	40.8
150500	5.61	88.4	11.11	44	7.45	40.4
151000	5.61	88.5	11.12	35	7.43	40.2
151500	5.6	88.4	11.11	32	7.4	39.9
152000	5.62	88	11.05	27.4	7.42	39.6

152500	5.63	88	11.05	27	7.43	39.4
153000	5.66	88	11.05	24.9	7.41	39.1
153500	5.69	88.5	11.1	20.9	7.42	38.7
154000	5.71	89.1	11.17	20.8	7.39	38.5
154500	5.73	87.8	11	13	7.41	38.3
155000	5.75	87.6	10.97	13.4	7.4	38.1
155500	5.76	87.3	10.93	11.7	7.35	38.2
160000	5.77	87.7	10.97	11.3	7.34	38.2
160500	5.79	87.3	10.92	11.3	7.35	38.1
161000						
161500						
162000						
162500						
163000						
163500						
164000						
164500						
165000						
165500						

Log File Name : FinnRock USFS data

Comments: Probe in low velocity water along South shore, depth 0.5 feet.

Specific conductance out of calibration (~10 times normal).

Time	Temp	DO%	DO	Turb	pH	SpCond
HHMMSS	øC	Sat	mg/l	NTUs	Units	uS/cm
91500						
92000						
92500						
93000						
93500						
94000						
94500						
95000						
95500	5.57	99.9	12.55	7.4	7.05	428
100000	5.57	97.4	12.23	7.6	7.09	428
100500	5.59	97.1	12.19	6.7	7.1	428
101000	5.57	97.2	12.21	6.7	7.11	428
101500	5.61	97	12.17	6.2	7.12	426
102000	5.58	97.3	12.22	6.4	7.13	426
102500	5.6	97.3	12.21	5.5	7.13	427
103000	5.59	97.1	12.19	5.9	7.14	427
103500	5.61	97.2	12.2	6.4	7.14	427
104000	5.61	97.3	12.21	7.7	7.15	426
104500	5.61	97.3	12.21	5.8	7.15	428
105000	5.61	97.3	12.21	6.4	7.15	427
105500	5.61	97.4	12.22	5.1	7.16	427
110000	5.62	97.5	12.23	5.5	7.16	426

110500	5.65	97.3	12.2	7.1	7.16	426
111000	5.64	97.7	12.25	5.5	7.16	427
111500	5.69	97.6	12.22	6	7.17	426
112000	5.68	97.5	12.21	4.9	7.17	425
112500	5.68	97.5	12.21	5.3	7.17	425
113000	5.68	97.4	12.2	6.1	7.18	426
113500	5.68	97.4	12.2	5.6	7.19	427
114000	5.7	97.3	12.18	5.4	7.19	425
114500	5.7	97.4	12.19	5.4	7.19	425
115000	5.71	97.4	12.19	5.3	7.19	425
115500	5.71	97.5	12.2	5.8	7.19	424
120000	5.71	97.3	12.18	5	7.2	425
120500	5.73	97.5	12.2	4.9	7.2	425
121000	5.75	97.4	12.18	5.6	7.2	424
121500	5.77	97.4	12.17	5.7	7.2	424
122000	5.77	97.2	12.15	5.4	7.21	425
122500	5.78	97.4	12.17	5.4	7.21	424
123000	5.81	97.4	12.16	5.4	7.21	424
123500	5.81	97.3	12.15	6.5	7.22	422
124000	5.8	97.4	12.16	5.4	7.21	424
124500	5.81	97.3	12.15	4.9	7.21	424
125000	5.82	97.3	12.14	4.7	7.21	423
125500	5.82	97.4	12.16	5.3	7.21	424
130000						
130500	5.88	97.3	12.13	6.1	7.22	425
131000	5.85	97.6	12.17	8.1	7.23	426
131500	5.85	97.5	12.16	6.1	7.22	427
132000	5.87	97.4	12.14	4.9	7.23	425
132500	5.88	97.2	12.11	5.6	7.23	425
133000	5.9	97.3	12.12	6	7.23	425
133500	5.9	97.6	12.16	6.6	7.23	424
134000	5.92	97.8	12.17	4.8	7.24	425
134500	5.93	97.7	12.16	4.4	7.22	422
135000	5.94	97.9	12.18	6.1	7.24	424
135500	5.95	97.8	12.17	5.7	7.23	425
140000	5.94	97.8	12.17	4.8	7.24	424
140500	5.95	97.8	12.17	5.3	7.23	424
141000	5.96	97.8	12.16	5.1	7.23	423
141500	5.96	97.9	12.18	6.4	7.23	424
142000	5.95	98.1	12.2	5.6	7.22	427
142500	5.96	98.1	12.2	6	7.22	425
143000	5.95	98.1	12.2	5.7	7.24	424
143500	5.95	98.3	12.23	5	7.23	426
144000	5.96	98.2	12.21	6.3	7.23	425
144500	5.98	98	12.18	11.4	7.22	422
145000	5.94	97.7	12.16	8	7.22	425
145500	5.93	97.6	12.15	18.9	7.25	432
150000	5.94	97.1	12.08	45.1	7.28	441
150500	5.91	96.6	12.03	79.4	7.42	468
151000	5.92	96.2	11.97	97.3	7.49	476

151500	5.89	95.7	11.92	125	7.56	492
152000	5.87	95.5	11.9	133	7.56	496
152500	5.83	95.2	11.88	132	7.53	497
153000	5.8	95.2	11.88	116	7.47	494
153500	5.78	95.1	11.88	98.7	7.42	488
154000	5.74	95.3	11.92	89.2	7.36	482
154500	5.72	95	11.88	77.6	7.31	476
155000	5.69	95.3	11.93	63.7	7.28	469
155500	5.69	94.9	11.88	57.5	7.25	465
160000	5.69	94.8	11.87	49.9	7.23	464
160500	5.69	95	11.89	44.6	7.22	457
161000	5.71	94.9	11.88	34.9	7.2	451
161500	5.72	95.2	11.91	32.6	7.19	450
162000	5.75	95.3	11.91	26.4	7.19	441
162500	5.77	95.2	11.9	22.1	7.19	440
163000	5.79	95.6	11.94	27.4	7.19	437
163500	5.8	94.9	11.85	17.7	7.18	436
164000	5.81	95.1	11.87	14.8	7.18	435
164500	5.83	95.2	11.88	15.3	7.17	435
165000	5.84	95.2	11.87	12.9	7.17	435
165500	5.85	95.4	11.9	11.7	7.18	436

TABLE B

Samples collected 5/15/02 between 1400 and 1745 hours

ClientNO	DatePrep	Parameter	Results	PQL	Units	Sample type	Flags
CUGRUS	5/21/2002	Barium	0.00137	0.005	mg/L	sample	J
CUGRUS	5/21/2002	Beryllium	0	0.002	mg/L	sample	
CUGRUS	5/21/2002	Chromium	0	0.01	mg/L	sample	
CUGRUS	5/21/2002	Copper	0	0.01	mg/L	sample	
CUGRUS	5/21/2002	Iron	0.0169	0.1	mg/L	sample	J
CUGRUS	5/21/2002	Manganese	0	0.01	mg/L	sample	
CUGRUS	5/21/2002	Nickel	0	0.01	mg/L	sample	
CUGRUS	5/21/2002	Sodium	1.92	1	mg/L	sample	
CUGRUS	5/21/2002	Zinc	0.00654	0.01	mg/L	sample	J
CUGRDS1	5/21/2002	Barium	0.0181	0.005	mg/L	sample	
CUGRDS1	5/21/2002	Beryllium	0	0.002	mg/L	sample	
CUGRDS1	5/21/2002	Chromium	0.00112	0.01	mg/L	sample	J
CUGRDS1	5/21/2002	Copper	0.00285	0.01	mg/L	sample	J
CUGRDS1	5/21/2002	Iron	2.48	0.1	mg/L	sample	
CUGRDS1	5/21/2002	Manganese	0.27	0.01	mg/L	sample	
CUGRDS1	5/21/2002	Nickel	0.00133	0.01	mg/L	sample	J
CUGRDS1	5/21/2002	Sodium	2.26	1	mg/L	sample	
CUGRDS1	5/21/2002	Zinc	0.006	0.01	mg/L	sample	J
CUGRDS2	5/21/2002	Barium	0.0201	0.005	mg/L	sample	
CUGRDS2	5/21/2002	Beryllium	0	0.002	mg/L	sample	
CUGRDS2	5/21/2002	Chromium	0.00156	0.01	mg/L	sample	J
CUGRDS2	5/21/2002	Copper	0.00375	0.01	mg/L	sample	J
CUGRDS2	5/21/2002	Iron	3.2	0.1	mg/L	sample	
CUGRDS2	5/21/2002	Manganese	0.274	0.01	mg/L	sample	
CUGRDS2	5/21/2002	Nickel	0.00171	0.01	mg/L	sample	J
CUGRDS2	5/21/2002	Sodium	2.28	1	mg/L	sample	
CUGRDS2	5/21/2002	Zinc	0.00605	0.01	mg/L	sample	J
CUGRHB	5/21/2002	Barium	0.00471	0.005	mg/L	sample	J
CUGRHB	5/21/2002	Beryllium	0	0.002	mg/L	sample	
CUGRHB	5/21/2002	Chromium	0	0.01	mg/L	sample	
CUGRHB	5/21/2002	Copper	0	0.01	mg/L	sample	
CUGRHB	5/21/2002	Iron	0.513	0.1	mg/L	sample	
CUGRHB	5/21/2002	Manganese	0.0282	0.01	mg/L	sample	
CUGRHB	5/21/2002	Nickel	0	0.01	mg/L	sample	
CUGRHB	5/21/2002	Sodium	2.83	1	mg/L	sample	
CUGRHB	5/21/2002	Zinc	0.00227	0.01	mg/L	sample	J
CUGRUS	5/21/2002	Barium	0.00137	0.005	mg/L	dup	J
CUGRUS	5/21/2002	Beryllium	0	0.002	mg/L	dup	
CUGRUS	5/21/2002	Chromium	0	0.01	mg/L	dup	
CUGRUS	5/21/2002	Copper	0	0.01	mg/L	dup	
CUGRUS	5/21/2002	Iron	0.0148	0.1	mg/L	dup	J
CUGRUS	5/21/2002	Manganese	0	0.01	mg/L	dup	
CUGRUS	5/21/2002	Nickel	0	0.01	mg/L	dup	
CUGRUS	5/21/2002	Sodium	1.88	1	mg/L	dup	
CUGRUS	5/21/2002	Zinc	0.0038	0.01	mg/L	dup	J

CUGRUS	5/21/2002	Barium	3.63	0.005	mg/L	ms	
CUGRUS	5/21/2002	Beryllium	0.0964	0.002	mg/L	ms	
CUGRUS	5/21/2002	Chromium	0.386	0.01	mg/L	ms	
CUGRUS	5/21/2002	Copper	0.456	0.01	mg/L	ms	
CUGRUS	5/21/2002	Iron	20.6	0.1	mg/L	ms	
CUGRUS	5/21/2002	Manganese	0.948	0.01	mg/L	ms	
CUGRUS	5/21/2002	Nickel	0.932	0.01	mg/L	ms	
CUGRUS	5/21/2002	Sodium	21	1	mg/L	ms	
CUGRUS	5/21/2002	Zinc	0.923	0.01	mg/L	ms	
CUGRUS	5/21/2002	Arsenic	0	0.001	mg/L	sample	
CUGRUS	5/21/2002	Antimony	0.00045	0.003	mg/L	sample	J B1
CUGRUS	5/21/2002	Cadmium	0	0.0005	mg/L	sample	
CUGRUS	5/21/2002	Lead	7.4e-005	0.0005	mg/L	sample	J B1
CUGRUS	5/21/2002	Selenium	0	0.003	mg/L	sample	
CUGRUS	5/21/2002	Silver	2.2e-005	0.0005	mg/L	sample	J B1
CUGRUS	5/21/2002	Thallium	9e-006	0.0005	mg/L	sample	J B1
CUGRDS1	5/21/2002	Arsenic	0.000528	0.001	mg/L	sample	J
CUGRDS1	5/21/2002	Antimony	0.000277	0.003	mg/L	sample	J B1
CUGRDS1	5/21/2002	Cadmium	0	0.0005	mg/L	sample	
CUGRDS1	5/21/2002	Lead	0.000475	0.0005	mg/L	sample	J B1
CUGRDS1	5/21/2002	Selenium	0	0.003	mg/L	sample	
CUGRDS1	5/21/2002	Silver	2.9e-005	0.0005	mg/L	sample	J B1
CUGRDS1	5/21/2002	Thallium	1.6e-005	0.0005	mg/L	sample	J B1
CUGRDS2	5/21/2002	Arsenic	0.000612	0.001	mg/L	sample	J
CUGRDS2	5/21/2002	Antimony	0.000219	0.003	mg/L	sample	J B1
CUGRDS2	5/21/2002	Cadmium	0	0.0005	mg/L	sample	
CUGRDS2	5/21/2002	Lead	0.000553	0.0005	mg/L	sample	B1
CUGRDS2	5/21/2002	Selenium	0	0.003	mg/L	sample	
CUGRDS2	5/21/2002	Silver	3.3e-005	0.0005	mg/L	sample	J B1
CUGRDS2	5/21/2002	Thallium	2.4e-005	0.0005	mg/L	sample	J B1
CUGRHB	5/21/2002	Arsenic	0.000236	0.001	mg/L	sample	J
CUGRHB	5/21/2002	Antimony	0.000167	0.003	mg/L	sample	J B1
CUGRHB	5/21/2002	Cadmium	0	0.0005	mg/L	sample	
CUGRHB	5/21/2002	Lead	0.000109	0.0005	mg/L	sample	J B1
CUGRHB	5/21/2002	Selenium	0	0.003	mg/L	sample	
CUGRHB	5/21/2002	Silver	1.1e-005	0.0005	mg/L	sample	J B1
CUGRHB	5/21/2002	Thallium	0	0.0005	mg/L	sample	
CUGRUS	5/21/2002	Arsenic	0	0.001	mg/L	dup	
CUGRUS	5/21/2002	Antimony	0.000314	0.003	mg/L	dup	J B1
CUGRUS	5/21/2002	Cadmium	0	0.0005	mg/L	dup	
CUGRUS	5/21/2002	Lead	0.0001	0.0005	mg/L	dup	J B1
CUGRUS	5/21/2002	Selenium	0	0.003	mg/L	dup	
CUGRUS	5/21/2002	Silver	1.5e-005	0.0005	mg/L	dup	J B1
CUGRUS	5/21/2002	Thallium	9e-006	0.0005	mg/L	dup	J B1
CUGRUS	5/21/2002	Arsenic	4.4	0.02	mg/L	ms	
CUGRUS	5/21/2002	Antimony	3.54	0.06	mg/L	ms	B2
CUGRUS	5/21/2002	Cadmium	0.115	0.01	mg/L	ms	
CUGRUS	5/21/2002	Lead	1.13	0.01	mg/L	ms	B2
CUGRUS	5/21/2002	Selenium	4.32	0.06	mg/L	ms	
CUGRUS	5/21/2002	Silver	0.67	0.01	mg/L	ms	B2

CUGRUS	5/21/2002	Thallium	4.02	0.01	mg/L	ms	B2
CUGRUS	5/17/2002	Mercury	0	0.0002	mg/L	sample	
CUGRDS1	5/17/2002	Mercury	0	0.0002	mg/L	sample	
CUGRDS2	5/17/2002	Mercury	0	0.0002	mg/L	sample	
CUGRHB	5/17/2002	Mercury	0	0.0002	mg/L	sample	
CUGRUS	5/22/2002	Tetrachloro-m-xylene	72.3		%	sample	
CUGRUS	5/22/2002	Decachlorobiphenyl	84.8		%	sample	
CUGRUS	5/22/2002	Aldrin	0	0.000954	ug/L	sample	
CUGRUS	5/22/2002	alpha-BHC	0	0.000954	ug/L	sample	
CUGRUS	5/22/2002	beta-BHC	0.000562	0.000954	ug/L	sample	J C2
CUGRUS	5/22/2002	delta-BHC	0	0.000954	ug/L	sample	
CUGRUS	5/22/2002	gamma-BHC (Lindane)	0	0.000954	ug/L	sample	
CUGRUS	5/22/2002	Chlordane (technical)	0	0.00954	ug/L	sample	
CUGRUS	5/22/2002	4,4'-DDD	0	0.00191	ug/L	sample	
CUGRUS	5/22/2002	4,4'-DDE	0	0.00191	ug/L	sample	
CUGRUS	5/22/2002	4,4'-DDT	0	0.00191	ug/L	sample	
CUGRUS	5/22/2002	Dieldrin	0	0.00191	ug/L	sample	
CUGRUS	5/22/2002	Endosulfan I	0	0.000954	ug/L	sample	
CUGRUS	5/22/2002	Endosulfan II	0	0.00191	ug/L	sample	
CUGRUS	5/22/2002	Endosulfan sulfate	0	0.00191	ug/L	sample	
CUGRUS	5/22/2002	Endrin	0	0.00191	ug/L	sample	
CUGRUS	5/22/2002	Endrin aldehyde	0	0.00191	ug/L	sample	
CUGRUS	5/22/2002	Heptachlor	0	0.000954	ug/L	sample	
CUGRUS	5/22/2002	Heptachlor epoxide	0	0.000954	ug/L	sample	
CUGRUS	5/22/2002	Methoxychlor	0	0.00954	ug/L	sample	
CUGRUS	5/22/2002	Endrin ketone	0	0.00191	ug/L	sample	
CUGRUS	5/22/2002	Toxaphene	0	0.0954	ug/L	sample	
CUGRDS1	5/22/2002	Tetrachloro-m-xylene	71		%	sample	
CUGRDS1	5/22/2002	Decachlorobiphenyl	84.2		%	sample	
CUGRDS1	5/22/2002	Aldrin	0	0.000968	ug/L	sample	
CUGRDS1	5/22/2002	alpha-BHC	0	0.000968	ug/L	sample	
CUGRDS1	5/22/2002	beta-BHC	0	0.000968	ug/L	sample	
CUGRDS1	5/22/2002	delta-BHC	0	0.000968	ug/L	sample	
CUGRDS1	5/22/2002	gamma-BHC (Lindane)	0	0.000968	ug/L	sample	
CUGRDS1	5/22/2002	Chlordane (technical)	0	0.00968	ug/L	sample	
CUGRDS1	5/22/2002	4,4'-DDD	0	0.00194	ug/L	sample	
CUGRDS1	5/22/2002	4,4'-DDE	0	0.00194	ug/L	sample	
CUGRDS1	5/22/2002	4,4'-DDT	0	0.00194	ug/L	sample	
CUGRDS1	5/22/2002	Dieldrin	0	0.00194	ug/L	sample	
CUGRDS1	5/22/2002	Endosulfan I	0	0.000968	ug/L	sample	
CUGRDS1	5/22/2002	Endosulfan II	0	0.00194	ug/L	sample	
CUGRDS1	5/22/2002	Endosulfan sulfate	0	0.00194	ug/L	sample	
CUGRDS1	5/22/2002	Endrin	0	0.00194	ug/L	sample	
CUGRDS1	5/22/2002	Endrin aldehyde	0	0.00194	ug/L	sample	
CUGRDS1	5/22/2002	Heptachlor	0	0.000968	ug/L	sample	
CUGRDS1	5/22/2002	Heptachlor epoxide	0	0.000968	ug/L	sample	
CUGRDS1	5/22/2002	Methoxychlor	0	0.00968	ug/L	sample	
CUGRDS1	5/22/2002	Endrin ketone	0	0.00194	ug/L	sample	
CUGRDS1	5/22/2002	Toxaphene	0	0.0968	ug/L	sample	
CUGRDS2	5/22/2002	Tetrachloro-m-xylene	71.5		%	sample	

CUGRDS2	5/22/2002	Decachlorobiphenyl	83.4		%	sample	
CUGRDS2	5/22/2002	Aldrin	0	0.000973	ug/L	sample	
CUGRDS2	5/22/2002	alpha-BHC	0	0.000973	ug/L	sample	
CUGRDS2	5/22/2002	beta-BHC	0	0.000973	ug/L	sample	
CUGRDS2	5/22/2002	delta-BHC	0	0.000973	ug/L	sample	
CUGRDS2	5/22/2002	gamma-BHC (Lindane)	0	0.000973	ug/L	sample	
CUGRDS2	5/22/2002	Chlordane (technical)	0	0.00973	ug/L	sample	
CUGRDS2	5/22/2002	4,4'-DDD	0	0.00195	ug/L	sample	
CUGRDS2	5/22/2002	4,4'-DDE	0	0.00195	ug/L	sample	
CUGRDS2	5/22/2002	4,4'-DDT	0.000599	0.00195	ug/L	sample	J C1
CUGRDS2	5/22/2002	Dieldrin	0	0.00195	ug/L	sample	
CUGRDS2	5/22/2002	Endosulfan I	0	0.000973	ug/L	sample	
CUGRDS2	5/22/2002	Endosulfan II	0	0.00195	ug/L	sample	
CUGRDS2	5/22/2002	Endosulfan sulfate	0	0.00195	ug/L	sample	
CUGRDS2	5/22/2002	Endrin	0	0.00195	ug/L	sample	
CUGRDS2	5/22/2002	Endrin aldehyde	0	0.00195	ug/L	sample	
CUGRDS2	5/22/2002	Heptachlor	0	0.000973	ug/L	sample	
CUGRDS2	5/22/2002	Heptachlor epoxide	0	0.000973	ug/L	sample	
CUGRDS2	5/22/2002	Methoxychlor	0	0.00973	ug/L	sample	
CUGRDS2	5/22/2002	Endrin ketone	0	0.00195	ug/L	sample	
CUGRDS2	5/22/2002	Toxaphene	0	0.0973	ug/L	sample	
CUGRHB	5/22/2002	Tetrachloro-m-xylene	72.4		%	sample	
CUGRHB	5/22/2002	Decachlorobiphenyl	83.1		%	sample	
CUGRHB	5/22/2002	Aldrin	0	0.000967	ug/L	sample	
CUGRHB	5/22/2002	alpha-BHC	0	0.000967	ug/L	sample	
CUGRHB	5/22/2002	beta-BHC	0	0.000967	ug/L	sample	
CUGRHB	5/22/2002	delta-BHC	0	0.000967	ug/L	sample	
CUGRHB	5/22/2002	gamma-BHC (Lindane)	0	0.000967	ug/L	sample	
CUGRHB	5/22/2002	Chlordane (technical)	0	0.00967	ug/L	sample	
CUGRHB	5/22/2002	4,4'-DDD	0	0.00193	ug/L	sample	
CUGRHB	5/22/2002	4,4'-DDE	0	0.00193	ug/L	sample	
CUGRHB	5/22/2002	4,4'-DDT	0	0.00193	ug/L	sample	
CUGRHB	5/22/2002	Dieldrin	0	0.00193	ug/L	sample	
CUGRHB	5/22/2002	Endosulfan I	0	0.000967	ug/L	sample	
CUGRHB	5/22/2002	Endosulfan II	0	0.00193	ug/L	sample	
CUGRHB	5/22/2002	Endosulfan sulfate	0	0.00193	ug/L	sample	
CUGRHB	5/22/2002	Endrin	0	0.00193	ug/L	sample	
CUGRHB	5/22/2002	Endrin aldehyde	0	0.00193	ug/L	sample	
CUGRHB	5/22/2002	Heptachlor	0	0.000967	ug/L	sample	
CUGRHB	5/22/2002	Heptachlor epoxide	0	0.000967	ug/L	sample	
CUGRHB	5/22/2002	Methoxychlor	0	0.00967	ug/L	sample	
CUGRHB	5/22/2002	Endrin ketone	0	0.00193	ug/L	sample	
CUGRHB	5/22/2002	Toxaphene	0	0.0967	ug/L	sample	
CUGRUS	5/20/2002	Tributyl Phosphate	84.2		%	sample	
CUGRUS	5/20/2002	Triphenyl Phosphate	67.8		%	sample	
CUGRUS	5/20/2002	Dichlorvos	0	0.192	ug/L	sample	
CUGRUS	5/20/2002	Mevinphos	0	0.192	ug/L	sample	
CUGRUS	5/20/2002	Ethoprop	0	0.289	ug/L	sample	
CUGRUS	5/20/2002	Naled	0	0.192	ug/L	sample	
CUGRUS	5/20/2002	Sulfotepp	0	0.0962	ug/L	sample	

CUGRUS	5/20/2002	Monocrotophos	0	0.0962	ug/L	sample	
CUGRUS	5/20/2002	Phorate	0	0.144	ug/L	sample	
CUGRUS	5/20/2002	Dimethoate	0	0.481	ug/L	sample	
CUGRUS	5/20/2002	Demeton,o-s	0	0.192	ug/L	sample	
CUGRUS	5/20/2002	Diazinon	0	0.192	ug/L	sample	
CUGRUS	5/20/2002	Disulfoton	0	0.144	ug/L	sample	
CUGRUS	5/20/2002	Parathion,methyl	0	0.289	ug/L	sample	
CUGRUS	5/20/2002	Ronnel	0	0.192	ug/L	sample	
CUGRUS	5/20/2002	Chlorpyrifos	0	0.144	ug/L	sample	
CUGRUS	5/20/2002	Malathion	0	0.192	ug/L	sample	
CUGRUS	5/20/2002	Fenthion	0	0.0962	ug/L	sample	
CUGRUS	5/20/2002	Parathion	0	0.144	ug/L	sample	
CUGRUS	5/20/2002	Trichloronate	0	0.0962	ug/L	sample	
CUGRUS	5/20/2002	Tetrachlorvinphos	0	0.0962	ug/L	sample	
CUGRUS	5/20/2002	Merphos	0	0.144	ug/L	sample	
CUGRUS	5/20/2002	Tokuthion	0	0.144	ug/L	sample	
CUGRUS	5/20/2002	Fensulfothion	0	0.144	ug/L	sample	
CUGRUS	5/20/2002	Bolstar	0	0.0962	ug/L	sample	
CUGRUS	5/20/2002	EPN	0	0.0962	ug/L	sample	
CUGRUS	5/20/2002	Azinphos,methyl	0	0.144	ug/L	sample	
CUGRUS	5/20/2002	Coumaphos	0	0.144	ug/L	sample	
CUGRDS1	5/20/2002	Tributyl Phosphate	76.8		%	sample	
CUGRDS1	5/20/2002	Triphenyl Phosphate	98		%	sample	
CUGRDS1	5/20/2002	Dichlorvos	0	0.193	ug/L	sample	
CUGRDS1	5/20/2002	Mevinphos	0	0.193	ug/L	sample	
CUGRDS1	5/20/2002	Ethoprop	0	0.29	ug/L	sample	
CUGRDS1	5/20/2002	Naled	0	0.193	ug/L	sample	
CUGRDS1	5/20/2002	Sulfotepp	0	0.0966	ug/L	sample	
CUGRDS1	5/20/2002	Monocrotophos	0	0.0966	ug/L	sample	
CUGRDS1	5/20/2002	Phorate	0	0.145	ug/L	sample	
CUGRDS1	5/20/2002	Dimethoate	0	0.483	ug/L	sample	
CUGRDS1	5/20/2002	Demeton,o-s	0	0.193	ug/L	sample	
CUGRDS1	5/20/2002	Diazinon	0.454	0.193	ug/L	sample	
CUGRDS1	5/20/2002	Disulfoton	0	0.145	ug/L	sample	
CUGRDS1	5/20/2002	Parathion,methyl	0	0.29	ug/L	sample	
CUGRDS1	5/20/2002	Ronnel	0	0.193	ug/L	sample	
CUGRDS1	5/20/2002	Chlorpyrifos	0	0.145	ug/L	sample	
CUGRDS1	5/20/2002	Malathion	0.155	0.193	ug/L	sample	J
CUGRDS1	5/20/2002	Fenthion	0	0.0966	ug/L	sample	
CUGRDS1	5/20/2002	Parathion	0	0.145	ug/L	sample	
CUGRDS1	5/20/2002	Trichloronate	0	0.0966	ug/L	sample	
CUGRDS1	5/20/2002	Tetrachlorvinphos	0	0.0966	ug/L	sample	
CUGRDS1	5/20/2002	Merphos	0	0.145	ug/L	sample	
CUGRDS1	5/20/2002	Tokuthion	0	0.145	ug/L	sample	
CUGRDS1	5/20/2002	Fensulfothion	0	0.145	ug/L	sample	
CUGRDS1	5/20/2002	Bolstar	0	0.0966	ug/L	sample	
CUGRDS1	5/20/2002	EPN	0	0.0966	ug/L	sample	
CUGRDS1	5/20/2002	Azinphos,methyl	0	0.145	ug/L	sample	
CUGRDS1	5/20/2002	Coumaphos	0	0.145	ug/L	sample	
CUGRDS2	5/20/2002	Tributyl Phosphate	82.9		%	sample	

CUGRDS2	5/20/2002	Triphenyl Phosphate	67.6		%	sample
CUGRDS2	5/20/2002	Dichlorvos	0	0.193	ug/L	sample
CUGRDS2	5/20/2002	Mevinphos	0	0.193	ug/L	sample
CUGRDS2	5/20/2002	Ethoprop	0	0.289	ug/L	sample
CUGRDS2	5/20/2002	Naled	0	0.193	ug/L	sample
CUGRDS2	5/20/2002	Sulfotepp	0	0.0963	ug/L	sample
CUGRDS2	5/20/2002	Monocrotophos	0	0.0963	ug/L	sample
CUGRDS2	5/20/2002	Phorate	0	0.145	ug/L	sample
CUGRDS2	5/20/2002	Dimethoate	0	0.482	ug/L	sample
CUGRDS2	5/20/2002	Demeton,o-s	0	0.193	ug/L	sample
CUGRDS2	5/20/2002	Diazinon	0	0.193	ug/L	sample
CUGRDS2	5/20/2002	Disulfoton	0	0.145	ug/L	sample
CUGRDS2	5/20/2002	Parathion,methyl	0	0.289	ug/L	sample
CUGRDS2	5/20/2002	Ronnel	0	0.193	ug/L	sample
CUGRDS2	5/20/2002	Chlorpyrifos	0	0.145	ug/L	sample
CUGRDS2	5/20/2002	Malathion	0	0.193	ug/L	sample
CUGRDS2	5/20/2002	Fenthion	0	0.0963	ug/L	sample
CUGRDS2	5/20/2002	Parathion	0	0.145	ug/L	sample
CUGRDS2	5/20/2002	Trichloronate	0	0.0963	ug/L	sample
CUGRDS2	5/20/2002	Tetrachlorvinphos	0	0.0963	ug/L	sample
CUGRDS2	5/20/2002	Merphos	0	0.145	ug/L	sample
CUGRDS2	5/20/2002	Tokuthion	0	0.145	ug/L	sample
CUGRDS2	5/20/2002	Fensulfothion	0	0.145	ug/L	sample
CUGRDS2	5/20/2002	Bolstar	0	0.0963	ug/L	sample
CUGRDS2	5/20/2002	EPN	0	0.0963	ug/L	sample
CUGRDS2	5/20/2002	Azinphos,methyl	0	0.145	ug/L	sample
CUGRDS2	5/20/2002	Coumaphos	0	0.145	ug/L	sample
CUGRHB	5/20/2002	Tributyl Phosphate	80.7		%	sample
CUGRHB	5/20/2002	Triphenyl Phosphate	99.8		%	sample
CUGRHB	5/20/2002	Dichlorvos	0	0.193	ug/L	sample
CUGRHB	5/20/2002	Mevinphos	0	0.193	ug/L	sample
CUGRHB	5/20/2002	Ethoprop	0	0.289	ug/L	sample
CUGRHB	5/20/2002	Naled	0	0.193	ug/L	sample
CUGRHB	5/20/2002	Sulfotepp	0	0.0964	ug/L	sample
CUGRHB	5/20/2002	Monocrotophos	0	0.0964	ug/L	sample
CUGRHB	5/20/2002	Phorate	0	0.145	ug/L	sample
CUGRHB	5/20/2002	Dimethoate	0	0.482	ug/L	sample
CUGRHB	5/20/2002	Demeton,o-s	0	0.193	ug/L	sample
CUGRHB	5/20/2002	Diazinon	0	0.193	ug/L	sample
CUGRHB	5/20/2002	Disulfoton	0	0.145	ug/L	sample
CUGRHB	5/20/2002	Parathion,methyl	0	0.289	ug/L	sample
CUGRHB	5/20/2002	Ronnel	0	0.193	ug/L	sample
CUGRHB	5/20/2002	Chlorpyrifos	0	0.145	ug/L	sample
CUGRHB	5/20/2002	Malathion	0	0.193	ug/L	sample
CUGRHB	5/20/2002	Fenthion	0	0.0964	ug/L	sample
CUGRHB	5/20/2002	Parathion	0	0.145	ug/L	sample
CUGRHB	5/20/2002	Trichloronate	0	0.0964	ug/L	sample
CUGRHB	5/20/2002	Tetrachlorvinphos	0	0.0964	ug/L	sample
CUGRHB	5/20/2002	Merphos	0	0.145	ug/L	sample
CUGRHB	5/20/2002	Tokuthion	0	0.145	ug/L	sample

CUGRHB	5/20/2002	Fensulfothion	0	0.145	ug/L	sample
CUGRHB	5/20/2002	Bolstar	0	0.0964	ug/L	sample
CUGRHB	5/20/2002	EPN	0	0.0964	ug/L	sample
CUGRHB	5/20/2002	Azinphos,methyl	0	0.145	ug/L	sample
CUGRHB	5/20/2002	Coumaphos	0	0.145	ug/L	sample
CUGRUS	5/20/2002	2,4-Dichlorophenylacetic acid	92.7		%	sample
CUGRUS	5/20/2002	Dalapon	0	0.0969	ug/L	sample
CUGRUS	5/20/2002	4-Nitrophenol	0	0.0969	ug/L	sample
CUGRUS	5/20/2002	Dicamba	0	0.0969	ug/L	sample
CUGRUS	5/20/2002	Dichloroprop	0	0.0969	ug/L	sample
CUGRUS	5/20/2002	2,4-D	0	0.0969	ug/L	sample
CUGRUS	5/20/2002	Pentachlorophenol	0	0.0969	ug/L	sample
CUGRUS	5/20/2002	Silvex (2,4,5-TP)	0	0.0969	ug/L	sample
CUGRUS	5/20/2002	2,4,5-T	0	0.194	ug/L	sample
CUGRUS	5/20/2002	Dinoseb	0	0.0969	ug/L	sample
CUGRUS	5/20/2002	2,4-DB	0	0.194	ug/L	sample
CUGRUS	5/20/2002	MCPP	0	0.0969	ug/L	sample
CUGRUS	5/20/2002	MCPA	0	0.0969	ug/L	sample
CUGRDS1	5/20/2002	2,4-Dichlorophenylacetic acid	90.4		%	sample
CUGRDS1	5/20/2002	Dalapon	0	0.0967	ug/L	sample
CUGRDS1	5/20/2002	4-Nitrophenol	0	0.0967	ug/L	sample
CUGRDS1	5/20/2002	Dicamba	0	0.0967	ug/L	sample
CUGRDS1	5/20/2002	Dichloroprop	0	0.0967	ug/L	sample
CUGRDS1	5/20/2002	2,4-D	0	0.0967	ug/L	sample
CUGRDS1	5/20/2002	Pentachlorophenol	0	0.0967	ug/L	sample
CUGRDS1	5/20/2002	Silvex (2,4,5-TP)	0	0.0967	ug/L	sample
CUGRDS1	5/20/2002	2,4,5-T	0	0.193	ug/L	sample
CUGRDS1	5/20/2002	Dinoseb	0	0.0967	ug/L	sample
CUGRDS1	5/20/2002	2,4-DB	0	0.193	ug/L	sample
CUGRDS1	5/20/2002	MCPP	0	0.0967	ug/L	sample
CUGRDS1	5/20/2002	MCPA	0	0.0967	ug/L	sample
CUGRDS2	5/20/2002	2,4-Dichlorophenylacetic acid	91		%	sample
CUGRDS2	5/20/2002	Dalapon	0	0.0961	ug/L	sample
CUGRDS2	5/20/2002	4-Nitrophenol	0	0.0961	ug/L	sample
CUGRDS2	5/20/2002	Dicamba	0	0.0961	ug/L	sample
CUGRDS2	5/20/2002	Dichloroprop	0	0.0961	ug/L	sample
CUGRDS2	5/20/2002	2,4-D	0	0.0961	ug/L	sample
CUGRDS2	5/20/2002	Pentachlorophenol	0	0.0961	ug/L	sample
CUGRDS2	5/20/2002	Silvex (2,4,5-TP)	0	0.0961	ug/L	sample
CUGRDS2	5/20/2002	2,4,5-T	0	0.192	ug/L	sample
CUGRDS2	5/20/2002	Dinoseb	0	0.0961	ug/L	sample
CUGRDS2	5/20/2002	2,4-DB	0	0.192	ug/L	sample
CUGRDS2	5/20/2002	MCPP	0	0.0961	ug/L	sample
CUGRDS2	5/20/2002	MCPA	0	0.0961	ug/L	sample
CUGRHB	5/20/2002	2,4-Dichlorophenylacetic acid	89.5		%	sample
CUGRHB	5/20/2002	Dalapon	0	0.096	ug/L	sample
CUGRHB	5/20/2002	4-Nitrophenol	0	0.096	ug/L	sample
CUGRHB	5/20/2002	Dicamba	0	0.096	ug/L	sample
CUGRHB	5/20/2002	Dichloroprop	0	0.096	ug/L	sample
CUGRHB	5/20/2002	2,4-D	0	0.096	ug/L	sample

CUGRHB	5/20/2002	Pentachlorophenol	0	0.096	ug/L	sample
CUGRHB	5/20/2002	Silvex (2,4,5-TP)	0	0.096	ug/L	sample
CUGRHB	5/20/2002	2,4,5-T	0	0.192	ug/L	sample
CUGRHB	5/20/2002	Dinoseb	0	0.096	ug/L	sample
CUGRHB	5/20/2002	2,4-DB	0	0.192	ug/L	sample
CUGRHB	5/20/2002	MCPP	0	0.096	ug/L	sample
CUGRHB	5/20/2002	MCPA	0	0.096	ug/L	sample
CUGRUS	5/22/2002	2 - Fluorophenol	44.5		%	sample
CUGRUS	5/22/2002	Phenol - d5	21.7		%	sample
CUGRUS	5/22/2002	Nitrobenzene - d5	104		%	sample
CUGRUS	5/22/2002	2 - Fluorobiphenyl	111		%	sample
CUGRUS	5/22/2002	2,4,6 - Tribromophenol	108		%	sample
CUGRUS	5/22/2002	p - Terphenyl - d14	109		%	sample
CUGRUS	5/22/2002	Naphthalene	0	0.096	ug/L	sample
CUGRUS	5/22/2002	2-Methylnaphthalene	0	0.96	ug/L	sample
CUGRUS	5/22/2002	2-Chloronaphthalene	0	0.096	ug/L	sample
CUGRUS	5/22/2002	Acenaphthylene	0	0.096	ug/L	sample
CUGRUS	5/22/2002	Acenaphthene	0	0.096	ug/L	sample
CUGRUS	5/22/2002	Fluorene	0	0.096	ug/L	sample
CUGRUS	5/22/2002	Phenanthrene	0	0.096	ug/L	sample
CUGRUS	5/22/2002	Anthracene	0	0.096	ug/L	sample
CUGRUS	5/22/2002	Fluoranthene	0	0.096	ug/L	sample
CUGRUS	5/22/2002	Pyrene	0	0.096	ug/L	sample
CUGRUS	5/22/2002	Benzo(a)anthracene	0	0.096	ug/L	sample
CUGRUS	5/22/2002	Chrysene	0	0.096	ug/L	sample
CUGRUS	5/22/2002	Benzofluoranthenes	0	0.192	ug/L	sample
CUGRUS	5/22/2002	Benzo(a)pyrene	0	0.096	ug/L	sample
CUGRUS	5/22/2002	Indeno(1,2,3-cd)pyrene	0	0.096	ug/L	sample
CUGRUS	5/22/2002	Dibenz(a,h)anthracene	0	0.096	ug/L	sample
CUGRUS	5/22/2002	Benzo(g,h,i)perylene	0	0.096	ug/L	sample
CUGRUS	5/22/2002	Atrazine	0	0.96	ug/L	sample
CUGRDS1	5/22/2002	2 - Fluorophenol	44.1		%	sample
CUGRDS1	5/22/2002	Phenol - d5	23.5		%	sample
CUGRDS1	5/22/2002	Nitrobenzene - d5	113		%	sample
CUGRDS1	5/22/2002	2 - Fluorobiphenyl	114		%	sample
CUGRDS1	5/22/2002	2,4,6 - Tribromophenol	103		%	sample
CUGRDS1	5/22/2002	p - Terphenyl - d14	109		%	sample
CUGRDS1	5/22/2002	Naphthalene	0	0.0995	ug/L	sample
CUGRDS1	5/22/2002	2-Methylnaphthalene	0	0.995	ug/L	sample
CUGRDS1	5/22/2002	2-Chloronaphthalene	0	0.0995	ug/L	sample
CUGRDS1	5/22/2002	Acenaphthylene	0	0.0995	ug/L	sample
CUGRDS1	5/22/2002	Acenaphthene	0	0.0995	ug/L	sample
CUGRDS1	5/22/2002	Fluorene	0	0.0995	ug/L	sample
CUGRDS1	5/22/2002	Phenanthrene	0	0.0995	ug/L	sample
CUGRDS1	5/22/2002	Anthracene	0	0.0995	ug/L	sample
CUGRDS1	5/22/2002	Fluoranthene	0	0.0995	ug/L	sample
CUGRDS1	5/22/2002	Pyrene	0	0.0995	ug/L	sample
CUGRDS1	5/22/2002	Benzo(a)anthracene	0	0.0995	ug/L	sample
CUGRDS1	5/22/2002	Chrysene	0	0.0995	ug/L	sample
CUGRDS1	5/22/2002	Benzofluoranthenes	0	0.199	ug/L	sample

CUGRDS1	5/22/2002	Benzo(a)pyrene	0	0.0995	ug/L	sample
CUGRDS1	5/22/2002	Indeno(1,2,3-cd)pyrene	0	0.0995	ug/L	sample
CUGRDS1	5/22/2002	Dibenz(a,h)anthracene	0	0.0995	ug/L	sample
CUGRDS1	5/22/2002	Benzo(g,h,i)perylene	0	0.0995	ug/L	sample
CUGRDS1	5/22/2002	Atrazine	0	0.995	ug/L	sample
CUGRDS2	5/22/2002	2 - Fluorophenol	37.9		%	sample
CUGRDS2	5/22/2002	Phenol - d5	20.4		%	sample
CUGRDS2	5/22/2002	Nitrobenzene - d5	108		%	sample
CUGRDS2	5/22/2002	2 - Fluorobiphenyl	112		%	sample
CUGRDS2	5/22/2002	2,4,6 - Tribromophenol	96.4		%	sample
CUGRDS2	5/22/2002	p - Terphenyl - d14	109		%	sample
CUGRDS2	5/22/2002	Naphthalene	0	0.0962	ug/L	sample
CUGRDS2	5/22/2002	2-Methylnaphthalene	0	0.962	ug/L	sample
CUGRDS2	5/22/2002	2-Chloronaphthalene	0	0.0962	ug/L	sample
CUGRDS2	5/22/2002	Acenaphthylene	0	0.0962	ug/L	sample
CUGRDS2	5/22/2002	Acenaphthene	0	0.0962	ug/L	sample
CUGRDS2	5/22/2002	Fluorene	0	0.0962	ug/L	sample
CUGRDS2	5/22/2002	Phenanthrene	0	0.0962	ug/L	sample
CUGRDS2	5/22/2002	Anthracene	0	0.0962	ug/L	sample
CUGRDS2	5/22/2002	Fluoranthene	0	0.0962	ug/L	sample
CUGRDS2	5/22/2002	Pyrene	0	0.0962	ug/L	sample
CUGRDS2	5/22/2002	Benzo(a)anthracene	0	0.0962	ug/L	sample
CUGRDS2	5/22/2002	Chrysene	0	0.0962	ug/L	sample
CUGRDS2	5/22/2002	Benzofluoranthenes	0	0.192	ug/L	sample
CUGRDS2	5/22/2002	Benzo(a)pyrene	0	0.0962	ug/L	sample
CUGRDS2	5/22/2002	Indeno(1,2,3-cd)pyrene	0	0.0962	ug/L	sample
CUGRDS2	5/22/2002	Dibenz(a,h)anthracene	0	0.0962	ug/L	sample
CUGRDS2	5/22/2002	Benzo(g,h,i)perylene	0	0.0962	ug/L	sample
CUGRDS2	5/22/2002	Atrazine	0	0.962	ug/L	sample
CUGRHB	5/22/2002	2 - Fluorophenol	37.4		%	sample
CUGRHB	5/22/2002	Phenol - d5	27.2		%	sample
CUGRHB	5/22/2002	Nitrobenzene - d5	104		%	sample
CUGRHB	5/22/2002	2 - Fluorobiphenyl	98		%	sample
CUGRHB	5/22/2002	2,4,6 - Tribromophenol	94.2		%	sample
CUGRHB	5/22/2002	p - Terphenyl - d14	91.5		%	sample
CUGRHB	5/22/2002	Naphthalene	0	0.0949	ug/L	sample
CUGRHB	5/22/2002	2-Methylnaphthalene	0	0.949	ug/L	sample
CUGRHB	5/22/2002	2-Chloronaphthalene	0	0.0949	ug/L	sample
CUGRHB	5/22/2002	Acenaphthylene	0	0.0949	ug/L	sample
CUGRHB	5/22/2002	Acenaphthene	0	0.0949	ug/L	sample
CUGRHB	5/22/2002	Fluorene	0	0.0949	ug/L	sample
CUGRHB	5/22/2002	Phenanthrene	0	0.0949	ug/L	sample
CUGRHB	5/22/2002	Anthracene	0	0.0949	ug/L	sample
CUGRHB	5/22/2002	Fluoranthene	0	0.0949	ug/L	sample
CUGRHB	5/22/2002	Pyrene	0	0.0949	ug/L	sample
CUGRHB	5/22/2002	Benzo(a)anthracene	0	0.0949	ug/L	sample
CUGRHB	5/22/2002	Chrysene	0	0.0949	ug/L	sample
CUGRHB	5/22/2002	Benzofluoranthenes	0	0.19	ug/L	sample
CUGRHB	5/22/2002	Benzo(a)pyrene	0	0.0949	ug/L	sample
CUGRHB	5/22/2002	Indeno(1,2,3-cd)pyrene	0	0.0949	ug/L	sample

CUGRHB	5/22/2002	Dibenz(a,h)anthracene	0	0.0949	ug/L	sample	
CUGRHB	5/22/2002	Benzo(g,h,i)perylene	0	0.0949	ug/L	sample	
CUGRHB	5/22/2002	Atrazine	0	0.949	ug/L	sample	
CUGRUS	5/17/2002	Fluoride	0	0.06	mg/L	sample	
CUGRUS	5/17/2002	Chloride	0.325	0.3	mg/L	sample	
CUGRUS	5/17/2002	Nitrite	0	0.031	mg/L	sample	
CUGRUS	5/17/2002	Nitrate	0	0.03	mg/L	sample	
CUGRUS	5/17/2002	Sulfate	0.192	0.3	mg/L	sample	J
CUGRDS1	5/17/2002	Fluoride	0	0.06	mg/L	sample	
CUGRDS1	5/17/2002	Chloride	0.473	0.3	mg/L	sample	
CUGRDS1	5/17/2002	Nitrite	0	0.031	mg/L	sample	
CUGRDS1	5/17/2002	Nitrate	0.014	0.03	mg/L	sample	J
CUGRDS1	5/17/2002	Sulfate	0.262	0.3	mg/L	sample	J
CUGRDS2	5/17/2002	Fluoride	0	0.06	mg/L	sample	
CUGRDS2	5/17/2002	Chloride	0.472	0.3	mg/L	sample	
CUGRDS2	5/17/2002	Nitrite	0	0.031	mg/L	sample	
CUGRDS2	5/17/2002	Nitrate	0.014	0.03	mg/L	sample	J
CUGRDS2	5/17/2002	Sulfate	0.273	0.3	mg/L	sample	J
CUGRHB	5/17/2002	Fluoride	0	0.06	mg/L	sample	
CUGRHB	5/17/2002	Chloride	0.789	0.3	mg/L	sample	
CUGRHB	5/17/2002	Nitrite	0	0.031	mg/L	sample	
CUGRHB	5/17/2002	Nitrate	0	0.03	mg/L	sample	
CUGRHB	5/17/2002	Sulfate	0.565	0.3	mg/L	sample	
CUGRUS	5/17/2002	Fluoride	0	0.06	mg/L	dup	
CUGRUS	5/17/2002	Chloride	0.324	0.3	mg/L	dup	
CUGRUS	5/17/2002	Nitrite	0	0.031	mg/L	dup	
CUGRUS	5/17/2002	Nitrate	0	0.03	mg/L	dup	
CUGRUS	5/17/2002	Sulfate	0.271	0.3	mg/L	dup	J
CUGRUS	5/17/2002	Fluoride	7.75	0.0606	mg/L	ms	
CUGRUS	5/17/2002	Chloride	40.1	0.303	mg/L	ms	
CUGRUS	5/17/2002	Nitrite	2.04	0.0313	mg/L	ms	
CUGRUS	5/17/2002	Nitrate	4.06	0.0303	mg/L	ms	
CUGRUS	5/17/2002	Sulfate	41.4	0.303	mg/L	ms	
CUGRUS	5/29/2002	TOC	0.809	0.5	mg/L	sample	
CUGRDS1	5/29/2002	TOC	1.34	0.5	mg/L	sample	
CUGRDS2	5/29/2002	TOC	1.27	0.5	mg/L	sample	
CUGRHB	5/29/2002	TOC	1.07	0.5	mg/L	sample	
CUGRUS	5/29/2002	TOC	10.2	0.5	mg/L	ms	
CUGRUS	5/29/2002	TOC	10.2	0.5	mg/L	msd	
	5/21/2002	Barium	0	0.005	mg/L	blank	
	5/21/2002	Beryllium	0	0.002	mg/L	blank	
	5/21/2002	Chromium	0	0.01	mg/L	blank	
	5/21/2002	Copper	0	0.01	mg/L	blank	
	5/21/2002	Iron	0	0.1	mg/L	blank	
	5/21/2002	Manganese	0	0.01	mg/L	blank	
	5/21/2002	Nickel	0	0.01	mg/L	blank	
	5/21/2002	Sodium	0	1	mg/L	blank	
	5/21/2002	Zinc	0	0.01	mg/L	blank	
	5/21/2002	Arsenic	0	0.001	mg/L	blank	
	5/21/2002	Antimony	0.000128	0.003	mg/L	blank	J

5/21/2002	Cadmium	0	0.0005	mg/L	blank	
5/21/2002	Lead	7.6e-005	0.0005	mg/L	blank	J
5/21/2002	Selenium	0	0.003	mg/L	blank	
5/21/2002	Silver	1e-005	0.0005	mg/L	blank	J
5/21/2002	Thallium	6e-006	0.0005	mg/L	blank	J
5/17/2002	Mercury	0	0.0002	mg/L	blank	
5/17/2002	Mercury	0.00239	0.0002	mg/L	bs	
5/17/2002	Mercury	0.00242	0.0002	mg/L	bsd	
5/22/2002	Tetrachloro-m-xylene	72.4		%	blank	
5/22/2002	Decachlorobiphenyl	88.4		%	blank	
5/22/2002	Aldrin	0	0.001	ug/L	blank	
5/22/2002	alpha-BHC	0	0.001	ug/L	blank	
5/22/2002	beta-BHC	0	0.001	ug/L	blank	
5/22/2002	delta-BHC	0	0.001	ug/L	blank	
5/22/2002	gamma-BHC (Lindane)	0	0.001	ug/L	blank	
5/22/2002	Chlordane (technical)	0	0.01	ug/L	blank	
5/22/2002	4,4'-DDD	0	0.002	ug/L	blank	
5/22/2002	4,4'-DDE	0	0.002	ug/L	blank	
5/22/2002	4,4'-DDT	0	0.002	ug/L	blank	
5/22/2002	Dieldrin	0	0.002	ug/L	blank	
5/22/2002	Endosulfan I	0	0.001	ug/L	blank	
5/22/2002	Endosulfan II	0	0.002	ug/L	blank	
5/22/2002	Endosulfan sulfate	0	0.002	ug/L	blank	
5/22/2002	Endrin	0	0.002	ug/L	blank	
5/22/2002	Endrin aldehyde	0	0.002	ug/L	blank	
5/22/2002	Heptachlor	0	0.001	ug/L	blank	
5/22/2002	Heptachlor epoxide	0	0.001	ug/L	blank	
5/22/2002	Methoxychlor	0	0.01	ug/L	blank	
5/22/2002	Endrin ketone	0	0.002	ug/L	blank	
5/22/2002	Toxaphene	0	0.1	ug/L	blank	
5/22/2002	Tetrachloro-m-xylene	76.9		%	bs	
5/22/2002	Decachlorobiphenyl	95.9		%	bs	
5/22/2002	Aldrin	0.017	0.001	ug/L	bs	C1
5/22/2002	gamma-BHC (Lindane)	0.0173	0.001	ug/L	bs	C1
5/22/2002	4,4'-DDT	0.0409	0.002	ug/L	bs	C1
5/22/2002	Dieldrin	0.0444	0.002	ug/L	bs	C1
5/22/2002	Endrin	0.048	0.002	ug/L	bs	C1
5/22/2002	Heptachlor	0.0175	0.001	ug/L	bs	C1
5/22/2002	Tetrachloro-m-xylene	72.8		%	bsd	
5/22/2002	Decachlorobiphenyl	85.9		%	bsd	
5/22/2002	Aldrin	0.0165	0.001	ug/L	bsd	C1
5/22/2002	gamma-BHC (Lindane)	0.0171	0.001	ug/L	bsd	C1
5/22/2002	4,4'-DDT	0.0401	0.002	ug/L	bsd	C1
5/22/2002	Dieldrin	0.0436	0.002	ug/L	bsd	C1
5/22/2002	Endrin	0.0465	0.002	ug/L	bsd	C1
5/22/2002	Heptachlor	0.0175	0.001	ug/L	bsd	C1
5/20/2002	Tributyl Phosphate	76.7		%	blank	
5/20/2002	Triphenyl Phosphate	109		%	blank	
5/20/2002	Dichlorvos	0	0.2	ug/L	blank	
5/20/2002	Mevinphos	0	0.2	ug/L	blank	

5/20/2002	Ethoprop	0	0.3	ug/L	blank
5/20/2002	Naled	0	0.2	ug/L	blank
5/20/2002	Sulfotepp	0	0.1	ug/L	blank
5/20/2002	Monocrotophos	0	0.1	ug/L	blank
5/20/2002	Phorate	0	0.15	ug/L	blank
5/20/2002	Dimethoate	0	0.5	ug/L	blank
5/20/2002	Demeton,o-s	0	0.2	ug/L	blank
5/20/2002	Diazinon	0	0.2	ug/L	blank
5/20/2002	Disulfoton	0	0.15	ug/L	blank
5/20/2002	Parathion,methyl	0	0.3	ug/L	blank
5/20/2002	Ronnel	0	0.2	ug/L	blank
5/20/2002	Chlorpyrifos	0	0.15	ug/L	blank
5/20/2002	Malathion	0	0.2	ug/L	blank
5/20/2002	Fenthion	0	0.1	ug/L	blank
5/20/2002	Parathion	0	0.15	ug/L	blank
5/20/2002	Trichloronate	0	0.1	ug/L	blank
5/20/2002	Tetrachlorvinphos	0	0.1	ug/L	blank
5/20/2002	Merphos	0	0.15	ug/L	blank
5/20/2002	Tokuthion	0	0.15	ug/L	blank
5/20/2002	Fensulfothion	0	0.15	ug/L	blank
5/20/2002	Bolstar	0	0.1	ug/L	blank
5/20/2002	EPN	0	0.1	ug/L	blank
5/20/2002	Azinphos,methyl	0	0.15	ug/L	blank
5/20/2002	Coumaphos	0	0.15	ug/L	blank
5/20/2002	Tributyl Phosphate	76.4		%	bs
5/20/2002	Triphenyl Phosphate	87.2		%	bs
5/20/2002	Diazinon	8.98	0.2	ug/L	bs
5/20/2002	Chlorpyrifos	9.17	0.15	ug/L	bs
5/20/2002	Malathion	9.11	0.2	ug/L	bs
5/20/2002	Azinphos,methyl	10.1	0.15	ug/L	bs
5/20/2002	Tributyl Phosphate	71.5		%	bsd
5/20/2002	Triphenyl Phosphate	70.4		%	bsd
5/20/2002	Diazinon	7.47	0.2	ug/L	bsd
5/20/2002	Chlorpyrifos	8.96	0.15	ug/L	bsd
5/20/2002	Malathion	7.22	0.2	ug/L	bsd
5/20/2002	Azinphos,methyl	9.5	0.15	ug/L	bsd
5/20/2002	2,4-Dichlorophenylacetic acid	100		%	blank
5/20/2002	Dalapon	0	0.1	ug/L	blank
5/20/2002	4-Nitrophenol	0	0.1	ug/L	blank
5/20/2002	Dicamba	0	0.1	ug/L	blank
5/20/2002	Dichloroprop	0	0.1	ug/L	blank
5/20/2002	2,4-D	0	0.1	ug/L	blank
5/20/2002	Pentachlorophenol	0	0.1	ug/L	blank
5/20/2002	Silvex (2,4,5-TP)	0	0.1	ug/L	blank
5/20/2002	2,4,5-T	0	0.2	ug/L	blank
5/20/2002	Dinoseb	0	0.1	ug/L	blank
5/20/2002	2,4-DB	0	0.2	ug/L	blank
5/20/2002	MCPP	0	0.1	ug/L	blank
5/20/2002	MCPA	0	0.1	ug/L	blank
5/20/2002	2,4-Dichlorophenylacetic acid	101		%	bs

5/20/2002	Dalapon	4.4	0.1	ug/L	bs
5/20/2002	Dicamba	8.4	0.1	ug/L	bs
5/20/2002	2,4-D	10.6	0.1	ug/L	bs
5/20/2002	Pentachlorophenol	10.1	0.1	ug/L	bs
5/20/2002	Silvex (2,4,5-TP)	11.1	0.1	ug/L	bs
5/20/2002	Dinoseb	9	0.1	ug/L	bs
5/20/2002	MCPP	11.2	0.1	ug/L	bs
5/20/2002	2,4-Dichlorophenylacetic acid	96.7		%	bsd
5/20/2002	Dalapon	4.02	0.1	ug/L	bsd
5/20/2002	Dicamba	8.42	0.1	ug/L	bsd
5/20/2002	2,4-D	10.4	0.1	ug/L	bsd
5/20/2002	Pentachlorophenol	9.72	0.1	ug/L	bsd
5/20/2002	Silvex (2,4,5-TP)	10.6	0.1	ug/L	bsd
5/20/2002	Dinoseb	8.89	0.1	ug/L	bsd
5/20/2002	MCPP	10.8	0.1	ug/L	bsd
5/22/2002	2 - Fluorophenol	61.8		%	blank
5/22/2002	Phenol - d5	40.2		%	blank
5/22/2002	2,4,6 - Tribromophenol	101		%	blank
5/22/2002	Phenol	0	1	ug/L	blank
5/22/2002	bis(2-Chloroethyl)ether	0	1	ug/L	blank
5/22/2002	2-Chlorophenol	0	1	ug/L	blank
5/22/2002	1,3-Dichlorobenzene	0	1	ug/L	blank
5/22/2002	1,4-Dichlorobenzene	0	1	ug/L	blank
5/22/2002	Benzyl Alcohol	0	1	ug/L	blank
5/22/2002	1,2-Dichlorobenzene	0	1	ug/L	blank
5/22/2002	2-Methylphenol	0	1	ug/L	blank
5/22/2002	bis(2-Chloroisopropyl)ether	0	1	ug/L	blank
5/22/2002	3-&4-Methylphenol	0	2	ug/L	blank
5/22/2002	N-nitroso-di-n-propylamine	0	1	ug/L	blank
5/22/2002	Hexachloroethane	0	1	ug/L	blank
5/22/2002	Nitrobenzene	0	1	ug/L	blank
5/22/2002	Isophorone	0	1	ug/L	blank
5/22/2002	2-Nitrophenol	0	1	ug/L	blank
5/22/2002	2,4-Dimethylphenol	0	1	ug/L	blank
5/22/2002	Benzoic Acid	0	5	ug/L	blank
5/22/2002	bis(2-Chloroethoxy)methane	0	1	ug/L	blank
5/22/2002	2,4-Dichlorophenol	0	1	ug/L	blank
5/22/2002	1,2,4-Trichlorobenzene	0	1	ug/L	blank
5/22/2002	Naphthalene	0	0.1	ug/L	blank
5/22/2002	4-Chloroaniline	0	1	ug/L	blank
5/22/2002	Hexachlorobutadiene	0	1	ug/L	blank
5/22/2002	4-Chloro-3-methylphenol	0	1	ug/L	blank
5/22/2002	2-Methylnaphthalene	0	1	ug/L	blank
5/22/2002	Hexachlorocyclopentadiene	0	1	ug/L	blank
5/22/2002	2,4,6-Trichlorophenol	0	1	ug/L	blank
5/22/2002	2,4,5-Trichlorophenol	0	1	ug/L	blank
5/22/2002	2-Chloronaphthalene	0	0.1	ug/L	blank
5/22/2002	2-Nitroaniline	0	1	ug/L	blank
5/22/2002	Dimethylphthalate	0	1	ug/L	blank
5/22/2002	Acenaphthylene	0	0.1	ug/L	blank

5/22/2002	2,6-Dinitrotoluene	0	1	ug/L	blank
5/22/2002	3-Nitroaniline	0	1	ug/L	blank
5/22/2002	Acenaphthene	0	0.1	ug/L	blank
5/22/2002	2,4-Dinitrophenol	0	5	ug/L	blank
5/22/2002	4-Nitrophenol	0	5	ug/L	blank
5/22/2002	Dibenzofuran	0	1	ug/L	blank
5/22/2002	2,4-Dinitrotoluene	0	1	ug/L	blank
5/22/2002	Diethylphthalate	0	1	ug/L	blank
5/22/2002	4-Chlorophenylphenylether	0	1	ug/L	blank
5/22/2002	Fluorene	0	0.1	ug/L	blank
5/22/2002	4-Nitroaniline	0	1	ug/L	blank
5/22/2002	4,6-Dinitro-2-methylphenol	0	5	ug/L	blank
5/22/2002	N-Nitrosodiphenylamine	0	1	ug/L	blank
5/22/2002	4-Bromophenylphenylether	0	1	ug/L	blank
5/22/2002	Hexachlorobenzene	0	1	ug/L	blank
5/22/2002	Pentachlorophenol	0	1	ug/L	blank
5/22/2002	Phenanthrene	0	0.1	ug/L	blank
5/22/2002	Anthracene	0	0.1	ug/L	blank
5/22/2002	Di-n-butylphthalate	0	5	ug/L	blank
5/22/2002	Fluoranthene	0	0.1	ug/L	blank
5/22/2002	Pyrene	0	0.1	ug/L	blank
5/22/2002	Butylbenzylphthalate	0	5	ug/L	blank
5/22/2002	3,3'-Dichlorobenzidine	0	1	ug/L	blank
5/22/2002	Benzo(a)anthracene	0	0.1	ug/L	blank
5/22/2002	Chrysene	0	0.1	ug/L	blank
5/22/2002	bis(2-Ethylhexyl)phthalate	0	1	ug/L	blank
5/22/2002	Di-n-octylphthalate	0	1	ug/L	blank
5/22/2002	Benzofluoranthenes	0	0.2	ug/L	blank
5/22/2002	Benzo(b)fluoranthene	0	0.1	ug/L	blank
5/22/2002	Benzo(k)fluoranthene	0	0.1	ug/L	blank
5/22/2002	Benzo(a)pyrene	0	0.1	ug/L	blank
5/22/2002	Indeno(1,2,3-cd)pyrene	0	0.1	ug/L	blank
5/22/2002	Dibenz(a,h)anthracene	0	0.1	ug/L	blank
5/22/2002	Benzo(g,h,i)perylene	0	0.1	ug/L	blank
5/22/2002	Atrazine	0	1	ug/L	blank
5/22/2002	2 - Fluorophenol	40.5		%	bs
5/22/2002	Phenol - d5	31.3		%	bs
5/22/2002	2,4,6 - Tribromophenol	104		%	bs
5/22/2002	Naphthalene	8.62	0.1	ug/L	bs
5/22/2002	2-Methylnaphthalene	9.16	1	ug/L	bs
5/22/2002	2-Chloronaphthalene	9.41	0.1	ug/L	bs
5/22/2002	Acenaphthylene	7.58	0.1	ug/L	bs
5/22/2002	Acenaphthene	10.1	0.1	ug/L	bs
5/22/2002	Fluorene	11	0.1	ug/L	bs
5/22/2002	Phenanthrene	8.1	0.1	ug/L	bs
5/22/2002	Anthracene	10.5	0.1	ug/L	bs
5/22/2002	Fluoranthene	8.3	0.1	ug/L	bs
5/22/2002	Pyrene	9.17	0.1	ug/L	bs
5/22/2002	Benzo(a)anthracene	9.11	0.1	ug/L	bs
5/22/2002	Chrysene	11.3	0.1	ug/L	bs

5/22/2002	Benzofluoranthenes	19.7	0.2	ug/L	bs
5/22/2002	Benzo(a)pyrene	9.41	0.1	ug/L	bs
5/22/2002	Indeno(1,2,3-cd)pyrene	9.98	0.1	ug/L	bs
5/22/2002	Dibenz(a,h)anthracene	9.86	0.1	ug/L	bs
5/22/2002	Benzo(g,h,i)perylene	10.2	0.1	ug/L	bs
5/22/2002	Atrazine	22.4	1	ug/L	bs
5/22/2002	2 - Fluorophenol	37.1		%	bsd
5/22/2002	Phenol - d5	25.1		%	bsd
5/22/2002	2,4,6 - Tribromophenol	87.5		%	bsd
5/22/2002	Naphthalene	7.56	0.1	ug/L	bsd
5/22/2002	2-Methylnaphthalene	7.6	1	ug/L	bsd
5/22/2002	2-Chloronaphthalene	7.43	0.1	ug/L	bsd
5/22/2002	Acenaphthylene	5.95	0.1	ug/L	bsd
5/22/2002	Acenaphthene	7.88	0.1	ug/L	bsd
5/22/2002	Fluorene	7.33	0.1	ug/L	bsd
5/22/2002	Phenanthrene	7.34	0.1	ug/L	bsd
5/22/2002	Anthracene	8.73	0.1	ug/L	bsd
5/22/2002	Fluoranthene	6.91	0.1	ug/L	bsd
5/22/2002	Pyrene	7.72	0.1	ug/L	bsd
5/22/2002	Benzo(a)anthracene	7.64	0.1	ug/L	bsd
5/22/2002	Chrysene	7.35	0.1	ug/L	bsd
5/22/2002	Benzofluoranthenes	17.2	0.2	ug/L	bsd
5/22/2002	Benzo(a)pyrene	7.95	0.1	ug/L	bsd
5/22/2002	Indeno(1,2,3-cd)pyrene	8.7	0.1	ug/L	bsd
5/22/2002	Dibenz(a,h)anthracene	8.43	0.1	ug/L	bsd
5/22/2002	Benzo(g,h,i)perylene	9.08	0.1	ug/L	bsd
5/22/2002	Atrazine	15.1	1	ug/L	bsd
5/17/2002	Nitrate	0	0.03	mg/L	blank
5/17/2002	Chloride	38.1	0.3	mg/L	bs
5/17/2002	Nitrite	1.98	0.031	mg/L	bs
5/17/2002	Nitrate	3.86	0.03	mg/L	bs
5/17/2002	Sulfate	39.7	0.3	mg/L	bs
5/29/2002	TOC	0	0.5	mg/L	blank

Samples collected on 6/3/02 at 0645 (CUGRHB2) and 0425 hours

ClientNO	DatAnal	Parameter	Results	PQL	Units	Sample Type	Flags
CUGRDS4	6/7/2002	Barium	0.00445	0.005	mg/L	sample	J
CUGRDS4	6/7/2002	Beryllium	0	0.002	mg/L	sample	
CUGRDS4	6/7/2002	Chromium	0.000641	0.01	mg/L	sample	J
CUGRDS4	6/7/2002	Copper	0	0.01	mg/L	sample	
CUGRDS4	6/7/2002	Iron	0.548	0.1	mg/L	sample	
CUGRDS4	6/7/2002	Manganese	0.0207	0.01	mg/L	sample	
CUGRDS4	6/7/2002	Nickel	0	0.01	mg/L	sample	
CUGRDS4	6/7/2002	Sodium	2.75	1	mg/L	sample	B1
CUGRDS4	6/7/2002	Zinc	0.00446	0.01	mg/L	sample	J B1
CUGRHB2	6/7/2002	Copper	0	0.01	mg/L	sample	
CUGRHB2	6/7/2002	Copper	0	0.01	mg/L	dup	
CUGRHB2	6/7/2002	Copper	0.459	0.01	mg/L	ms	
CUGRDS4	6/10/2002	Arsenic	0.000625	0.001	mg/L	sample	J
CUGRDS4	6/10/2002	Antimony	0.000656	0.003	mg/L	sample	J B1

CUGRDS4	6/10/2002	Cadmium	0	0.0005	mg/L	sample	
CUGRDS4	6/10/2002	Lead	0.000143	0.0005	mg/L	sample	J B1
CUGRDS4	6/10/2002	Selenium	0	0.003	mg/L	sample	
CUGRDS4	6/10/2002	Silver	0.000103	0.0005	mg/L	sample	J B1
CUGRDS4	6/10/2002	Thallium	8.9e-005	0.0005	mg/L	sample	J
CUGRHB2	6/10/2002	Arsenic	0.000265	0.001	mg/L	sample	J
CUGRHB2	6/10/2002	Antimony	0.000764	0.003	mg/L	sample	J B1
CUGRHB2	6/10/2002	Cadmium	0	0.0005	mg/L	sample	
CUGRHB2	6/10/2002	Lead	0.000318	0.0005	mg/L	sample	J B1
CUGRHB2	6/10/2002	Selenium	0	0.003	mg/L	sample	
CUGRHB2	6/10/2002	Silver	0.000262	0.0005	mg/L	sample	J B1
CUGRHB2	6/10/2002	Thallium	2.6e-005	0.0005	mg/L	sample	J
CUGRDS4	6/12/2002	Mercury	0	0.0002	mg/L	sample	
CUGRHB2	6/12/2002	Mercury	0	0.0002	mg/L	sample	
CUGRDS4	6/14/2002	Tetrachloro-m-xylene	75.6		%	sample	
CUGRDS4	6/14/2002	Decachlorobiphenyl	90.2		%	sample	
CUGRDS4	6/14/2002	Aldrin	0	0.00102	ug/L	sample	
CUGRDS4	6/14/2002	alpha-BHC	0	0.00102	ug/L	sample	
CUGRDS4	6/14/2002	beta-BHC	0	0.00102	ug/L	sample	
CUGRDS4	6/14/2002	delta-BHC	0	0.00102	ug/L	sample	
CUGRDS4	6/14/2002	gamma-BHC (Lindane)	0	0.00102	ug/L	sample	
CUGRDS4	6/14/2002	Chlordane (technical)	0	0.0102	ug/L	sample	
CUGRDS4	6/14/2002	4,4'-DDD	0	0.00204	ug/L	sample	
CUGRDS4	6/14/2002	4,4'-DDE	0	0.00204	ug/L	sample	
CUGRDS4	6/14/2002	4,4'-DDT	0	0.00204	ug/L	sample	
CUGRDS4	6/14/2002	Dieldrin	0	0.00204	ug/L	sample	
CUGRDS4	6/14/2002	Endosulfan I	0	0.00102	ug/L	sample	
CUGRDS4	6/14/2002	Endosulfan II	0	0.00204	ug/L	sample	
CUGRDS4	6/14/2002	Endosulfan sulfate	0	0.00204	ug/L	sample	
CUGRDS4	6/14/2002	Endrin	0	0.00204	ug/L	sample	
CUGRDS4	6/14/2002	Endrin aldehyde	0	0.00204	ug/L	sample	
CUGRDS4	6/14/2002	Heptachlor	0	0.00102	ug/L	sample	
CUGRDS4	6/14/2002	Heptachlor epoxide	0	0.00102	ug/L	sample	
CUGRDS4	6/14/2002	Methoxychlor	0	0.0102	ug/L	sample	
CUGRDS4	6/14/2002	Endrin ketone	0	0.00204	ug/L	sample	
CUGRDS4	6/14/2002	Toxaphene	0	0.102	ug/L	sample	
CUGRHB2	6/14/2002	Tetrachloro-m-xylene	78.9		%	sample	
CUGRHB2	6/14/2002	Decachlorobiphenyl	91.2		%	sample	
CUGRHB2	6/14/2002	Aldrin	0	0.000956	ug/L	sample	
CUGRHB2	6/14/2002	alpha-BHC	0	0.000956	ug/L	sample	
CUGRHB2	6/14/2002	beta-BHC	0	0.000956	ug/L	sample	
CUGRHB2	6/14/2002	delta-BHC	0	0.000956	ug/L	sample	
CUGRHB2	6/14/2002	gamma-BHC (Lindane)	0	0.000956	ug/L	sample	
CUGRHB2	6/14/2002	Chlordane (technical)	0	0.00956	ug/L	sample	
CUGRHB2	6/14/2002	4,4'-DDD	0	0.00191	ug/L	sample	
CUGRHB2	6/14/2002	4,4'-DDE	0	0.00191	ug/L	sample	
CUGRHB2	6/14/2002	4,4'-DDT	0	0.00191	ug/L	sample	
CUGRHB2	6/14/2002	Dieldrin	0	0.00191	ug/L	sample	
CUGRHB2	6/14/2002	Endosulfan I	0	0.000956	ug/L	sample	
CUGRHB2	6/14/2002	Endosulfan II	0	0.00191	ug/L	sample	

CUGRHB2	6/14/2002	Endosulfan sulfate	0	0.00191	ug/L	sample
CUGRHB2	6/14/2002	Endrin	0	0.00191	ug/L	sample
CUGRHB2	6/14/2002	Endrin aldehyde	0	0.00191	ug/L	sample
CUGRHB2	6/14/2002	Heptachlor	0	0.000956	ug/L	sample
CUGRHB2	6/14/2002	Heptachlor epoxide	0	0.000956	ug/L	sample
CUGRHB2	6/14/2002	Methoxychlor	0	0.00956	ug/L	sample
CUGRHB2	6/14/2002	Endrin ketone	0	0.00191	ug/L	sample
CUGRHB2	6/14/2002	Toxaphene	0	0.0956	ug/L	sample
CUGRDS4	6/10/2002	Tributyl Phosphate	89.7		%	sample
CUGRDS4	6/10/2002	Triphenyl Phosphate	84.2		%	sample
CUGRDS4	6/10/2002	Dichlorvos	0	0.0198	ug/L	sample
CUGRDS4	6/10/2002	Mevinphos	0	0.0198	ug/L	sample
CUGRDS4	6/10/2002	Ethoprop	0	0.0297	ug/L	sample
CUGRDS4	6/10/2002	Naled	0	0.0198	ug/L	sample
CUGRDS4	6/10/2002	Sulfotepp	0	0.0099	ug/L	sample
CUGRDS4	6/10/2002	Monocrotophos	0	0.0099	ug/L	sample
CUGRDS4	6/10/2002	Phorate	0	0.0149	ug/L	sample
CUGRDS4	6/10/2002	Dimethoate	0	0.0495	ug/L	sample
CUGRDS4	6/10/2002	Demeton,o-s	0	0.0198	ug/L	sample
CUGRDS4	6/10/2002	Diazinon	0	0.0198	ug/L	sample
CUGRDS4	6/10/2002	Disulfoton	0	0.0149	ug/L	sample
CUGRDS4	6/10/2002	Parathion,methyl	0	0.0297	ug/L	sample
CUGRDS4	6/10/2002	Ronnel	0	0.0198	ug/L	sample
CUGRDS4	6/10/2002	Chlorpyrifos	0	0.0149	ug/L	sample
CUGRDS4	6/10/2002	Malathion	0	0.0198	ug/L	sample
CUGRDS4	6/10/2002	Fenthion	0	0.0099	ug/L	sample
CUGRDS4	6/10/2002	Parathion	0	0.0149	ug/L	sample
CUGRDS4	6/10/2002	Trichloronate	0	0.0099	ug/L	sample
CUGRDS4	6/10/2002	Tetrachlorvinphos	0	0.0099	ug/L	sample
CUGRDS4	6/10/2002	Merphos	0	0.0149	ug/L	sample
CUGRDS4	6/10/2002	Tokuthion	0	0.0149	ug/L	sample
CUGRDS4	6/10/2002	Fensulfothion	0	0.0149	ug/L	sample
CUGRDS4	6/10/2002	Bolstar	0	0.0099	ug/L	sample
CUGRDS4	6/10/2002	EPN	0	0.0099	ug/L	sample
CUGRDS4	6/10/2002	Azinphos,methyl	0	0.0149	ug/L	sample
CUGRDS4	6/10/2002	Coumaphos	0	0.0149	ug/L	sample
CUGRHB2	6/10/2002	Tributyl Phosphate	96.5		%	sample
CUGRHB2	6/10/2002	Triphenyl Phosphate	90.7		%	sample
CUGRHB2	6/10/2002	Dichlorvos	0	0.019	ug/L	sample
CUGRHB2	6/10/2002	Mevinphos	0	0.019	ug/L	sample
CUGRHB2	6/10/2002	Ethoprop	0	0.0285	ug/L	sample
CUGRHB2	6/10/2002	Naled	0	0.019	ug/L	sample
CUGRHB2	6/10/2002	Sulfotepp	0	0.00951	ug/L	sample
CUGRHB2	6/10/2002	Monocrotophos	0	0.00951	ug/L	sample
CUGRHB2	6/10/2002	Phorate	0	0.0143	ug/L	sample
CUGRHB2	6/10/2002	Dimethoate	0	0.0476	ug/L	sample
CUGRHB2	6/10/2002	Demeton,o-s	0	0.019	ug/L	sample
CUGRHB2	6/10/2002	Diazinon	0	0.019	ug/L	sample
CUGRHB2	6/10/2002	Disulfoton	0	0.0143	ug/L	sample
CUGRHB2	6/10/2002	Parathion,methyl	0	0.0285	ug/L	sample

CUGRHB2	6/10/2002	Ronnel	0	0.019	ug/L	sample
CUGRHB2	6/10/2002	Chlorpyrifos	0	0.0143	ug/L	sample
CUGRHB2	6/10/2002	Malathion	0	0.019	ug/L	sample
CUGRHB2	6/10/2002	Fenthion	0	0.00951	ug/L	sample
CUGRHB2	6/10/2002	Parathion	0	0.0143	ug/L	sample
CUGRHB2	6/10/2002	Trichloronate	0	0.00951	ug/L	sample
CUGRHB2	6/10/2002	Tetrachlorvinphos	0	0.00951	ug/L	sample
CUGRHB2	6/10/2002	Merphos	0	0.0143	ug/L	sample
CUGRHB2	6/10/2002	Tokuthion	0	0.0143	ug/L	sample
CUGRHB2	6/10/2002	Fensulfothion	0	0.0143	ug/L	sample
CUGRHB2	6/10/2002	Bolstar	0	0.00951	ug/L	sample
CUGRHB2	6/10/2002	EPN	0	0.00951	ug/L	sample
CUGRHB2	6/10/2002	Azinphos,methyl	0	0.0143	ug/L	sample
CUGRHB2	6/10/2002	Coumaphos	0	0.0143	ug/L	sample
CUGRDS4	6/10/2002	2,4-Dichlorophenylacetic acid	101		%	sample
CUGRDS4	6/10/2002	Dalapon	0	0.0497	ug/L	sample
CUGRDS4	6/10/2002	4-Nitrophenol	0	0.0497	ug/L	sample
CUGRDS4	6/10/2002	Dicamba	0	0.0497	ug/L	sample
CUGRDS4	6/10/2002	Dichloroprop	0	0.0497	ug/L	sample
CUGRDS4	6/10/2002	2,4-D	0	0.0497	ug/L	sample
CUGRDS4	6/10/2002	Pentachlorophenol	0	0.0497	ug/L	sample
CUGRDS4	6/10/2002	Silvex (2,4,5-TP)	0	0.0497	ug/L	sample
CUGRDS4	6/10/2002	2,4,5-T	0	0.0994	ug/L	sample
CUGRDS4	6/10/2002	Dinoseb	0	0.0497	ug/L	sample
CUGRDS4	6/10/2002	2,4-DB	0	0.0994	ug/L	sample
CUGRDS4	6/10/2002	MCPP	0	0.0497	ug/L	sample
CUGRDS4	6/10/2002	MCPA	0	0.0497	ug/L	sample
CUGRHB2	6/10/2002	2,4-Dichlorophenylacetic acid	102		%	sample
CUGRHB2	6/10/2002	Dalapon	0	0.0479	ug/L	sample
CUGRHB2	6/10/2002	4-Nitrophenol	0	0.0479	ug/L	sample
CUGRHB2	6/10/2002	Dicamba	0	0.0479	ug/L	sample
CUGRHB2	6/10/2002	Dichloroprop	0	0.0479	ug/L	sample
CUGRHB2	6/10/2002	2,4-D	0	0.0479	ug/L	sample
CUGRHB2	6/10/2002	Pentachlorophenol	0	0.0479	ug/L	sample
CUGRHB2	6/10/2002	Silvex (2,4,5-TP)	0	0.0479	ug/L	sample
CUGRHB2	6/10/2002	2,4,5-T	0	0.0958	ug/L	sample
CUGRHB2	6/10/2002	Dinoseb	0	0.0479	ug/L	sample
CUGRHB2	6/10/2002	2,4-DB	0	0.0958	ug/L	sample
CUGRHB2	6/10/2002	MCPP	0	0.0479	ug/L	sample
CUGRHB2	6/10/2002	MCPA	0	0.0479	ug/L	sample
CUGRDS4	6/10/2002	Nitrobenzene - d5	64.5		%	sample
CUGRDS4	6/10/2002	2 - Fluorobiphenyl	59.3		%	sample
CUGRDS4	6/10/2002	p - Terphenyl - d14	74.7		%	sample
CUGRDS4	6/10/2002	Naphthalene	0	0.00982	ug/L	sample
CUGRDS4	6/10/2002	2-Methylnaphthalene	0	0.0982	ug/L	sample
CUGRDS4	6/10/2002	2-Chloronaphthalene	0	0.00982	ug/L	sample
CUGRDS4	6/10/2002	Acenaphthylene	0	0.00982	ug/L	sample
CUGRDS4	6/10/2002	Acenaphthene	0	0.00982	ug/L	sample
CUGRDS4	6/10/2002	Fluorene	0	0.00982	ug/L	sample
CUGRDS4	6/10/2002	Phenanthrene	0	0.00982	ug/L	sample

CUGRDS4	6/10/2002	Anthracene	0	0.00982	ug/L	sample	
CUGRDS4	6/10/2002	Fluoranthene	0	0.00982	ug/L	sample	
CUGRDS4	6/10/2002	Pyrene	0	0.00982	ug/L	sample	
CUGRDS4	6/10/2002	Benzo(a)anthracene	0	0.00982	ug/L	sample	
CUGRDS4	6/10/2002	Chrysene	0	0.00982	ug/L	sample	
CUGRDS4	6/10/2002	Benzofluoranthenes	0	0.0196	ug/L	sample	
CUGRDS4	6/10/2002	Benzo(a)pyrene	0	0.00982	ug/L	sample	
CUGRDS4	6/10/2002	Indeno(1,2,3-cd)pyrene	0	0.00982	ug/L	sample	
CUGRDS4	6/10/2002	Dibenz(a,h)anthracene	0	0.00982	ug/L	sample	
CUGRDS4	6/10/2002	Benzo(g,h,i)perylene	0	0.00982	ug/L	sample	
CUGRDS4	6/10/2002	Atrazine	0	0.0982	ug/L	sample	
CUGRHB2	6/10/2002	Nitrobenzene - d5	66.9		%	sample	
CUGRHB2	6/10/2002	2 - Fluorobiphenyl	54.8		%	sample	N
CUGRHB2	6/10/2002	p - Terphenyl - d14	78.1		%	sample	
CUGRHB2	6/10/2002	Naphthalene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	2-Methylnaphthalene	0	0.0955	ug/L	sample	
CUGRHB2	6/10/2002	2-Chloronaphthalene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	Acenaphthylene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	Acenaphthene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	Fluorene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	Phenanthrene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	Anthracene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	Fluoranthene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	Pyrene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	Benzo(a)anthracene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	Chrysene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	Benzofluoranthenes	0	0.0191	ug/L	sample	
CUGRHB2	6/10/2002	Benzo(a)pyrene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	Indeno(1,2,3-cd)pyrene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	Dibenz(a,h)anthracene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	Benzo(g,h,i)perylene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	Atrazine	0	0.0955	ug/L	sample	
CUGRDS4	6/6/2002	Fluoride	0	0.06	mg/L	sample	
CUGRDS4	6/6/2002	Chloride	0.368	0.3	mg/L	sample	
CUGRDS4	6/6/2002	Nitrite as N	0	0.031	mg/L	sample	
CUGRDS4	6/6/2002	Nitrate as N	0.017	0.03	mg/L	sample	J
CUGRDS4	6/6/2002	Sulfate	0.237	0.3	mg/L	sample	J
CUGRHB2	6/6/2002	Fluoride	0	0.06	mg/L	sample	
CUGRHB2	6/6/2002	Chloride	0.683	0.3	mg/L	sample	
CUGRHB2	6/6/2002	Nitrite as N	0	0.031	mg/L	sample	
CUGRHB2	6/6/2002	Nitrate as N	0	0.03	mg/L	sample	
CUGRHB2	6/6/2002	Sulfate	0.546	0.3	mg/L	sample	
CUGRDS4	6/6/2002	Fluoride	0	0.06	mg/L	dup	
CUGRDS4	6/6/2002	Chloride	0.368	0.3	mg/L	dup	
CUGRDS4	6/6/2002	Nitrite as N	0	0.031	mg/L	dup	
CUGRDS4	6/6/2002	Nitrate as N	0.017	0.03	mg/L	dup	J
CUGRDS4	6/6/2002	Sulfate	0.266	0.3	mg/L	dup	J
CUGRDS4	6/6/2002	Fluoride	7.98	0.0606	mg/L	ms	
CUGRDS4	6/6/2002	Chloride	40.2	0.303	mg/L	ms	
CUGRDS4	6/6/2002	Nitrite as N	2.05	0.0313	mg/L	ms	

CUGRDS4	6/6/2002	Nitrate as N	4.05	0.0303	mg/L	ms	
CUGRDS4	6/6/2002	Sulfate	41.1	0.303	mg/L	ms	
CUGRDS4	6/13/2002	TOC	1.76	0.5	mg/L	sample	
CUGRHB2	6/13/2002	TOC	1.36	0.5	mg/L	sample	
CUGRDS4	6/13/2002	TOC	12	0.5	mg/L	ms	
CUGRDS4	6/13/2002	TOC	12.2	0.5	mg/L	msd	
	6/7/2002	Barium	0	0.005	mg/L	blank	
	6/7/2002	Beryllium	0	0.002	mg/L	blank	
	6/7/2002	Chromium	0	0.01	mg/L	blank	
	6/7/2002	Copper	0	0.01	mg/L	blank	
	6/7/2002	Iron	0	0.1	mg/L	blank	
	6/7/2002	Manganese	0	0.01	mg/L	blank	
	6/7/2002	Nickel	0	0.01	mg/L	blank	
	6/7/2002	Sodium	0.647	1	mg/L	blank	J
	6/7/2002	Zinc	0.0012	0.01	mg/L	blank	J
	6/12/2002	Mercury	0	0.0002	mg/L	blank	
	6/13/2002	Tetrachloro-m-xylene	68.4		%	blank	N
	6/13/2002	Decachlorobiphenyl	80.7		%	blank	
	6/13/2002	Aldrin	0	0.001	ug/L	blank	
	6/13/2002	alpha-BHC	0	0.001	ug/L	blank	
	6/13/2002	beta-BHC	0	0.001	ug/L	blank	
	6/13/2002	delta-BHC	0	0.001	ug/L	blank	
	6/13/2002	gamma-BHC (Lindane)	0	0.001	ug/L	blank	
	6/13/2002	Chlordane (technical)	0	0.01	ug/L	blank	
	6/13/2002	4,4'-DDD	0	0.002	ug/L	blank	
	6/13/2002	4,4'-DDE	0	0.002	ug/L	blank	
	6/13/2002	4,4'-DDT	0	0.002	ug/L	blank	
	6/13/2002	Dieldrin	0	0.002	ug/L	blank	
	6/13/2002	Endosulfan I	0	0.001	ug/L	blank	
	6/13/2002	Endosulfan II	0	0.002	ug/L	blank	
	6/13/2002	Endosulfan sulfate	0	0.002	ug/L	blank	
	6/13/2002	Endrin	0	0.002	ug/L	blank	
	6/13/2002	Endrin aldehyde	0	0.002	ug/L	blank	
	6/13/2002	Heptachlor	0	0.001	ug/L	blank	
	6/13/2002	Heptachlor epoxide	0	0.001	ug/L	blank	
	6/13/2002	Methoxychlor	0	0.01	ug/L	blank	
	6/13/2002	Endrin ketone	0	0.002	ug/L	blank	
	6/13/2002	Toxaphene	0	0.1	ug/L	blank	
	6/13/2002	Tetrachloro-m-xylene	77		%	bs	
	6/13/2002	Decachlorobiphenyl	90.8		%	bs	
	6/13/2002	Aldrin	0.017	0.001	ug/L	bs	C1
	6/13/2002	gamma-BHC (Lindane)	0.0176	0.001	ug/L	bs	C1
	6/13/2002	4,4'-DDT	0.0457	0.002	ug/L	bs	C1
	6/13/2002	Dieldrin	0.0414	0.002	ug/L	bs	C1
	6/13/2002	Endrin	0.0369	0.002	ug/L	bs	C1
	6/13/2002	Heptachlor	0.0162	0.001	ug/L	bs	C1
	6/14/2002	Tetrachloro-m-xylene	77.6		%	bsd	
	6/14/2002	Decachlorobiphenyl	88.7		%	bsd	
	6/14/2002	Aldrin	0.0197	0.001	ug/L	bsd	C1
	6/14/2002	gamma-BHC (Lindane)	0.0192	0.001	ug/L	bsd	C1

6/14/2002	4,4'-DDT	0.0477	0.002	ug/L	bsd	C1
6/14/2002	Dieldrin	0.0454	0.002	ug/L	bsd	C1
6/14/2002	Endrin	0.0404	0.002	ug/L	bsd	C1
6/14/2002	Heptachlor	0.0184	0.001	ug/L	bsd	C1
6/10/2002	Tributyl Phosphate	76.7		%	blank	
6/10/2002	Triphenyl Phosphate	86.1		%	blank	
6/10/2002	Dichlorvos	0	0.02	ug/L	blank	
6/10/2002	Mevinphos	0	0.02	ug/L	blank	
6/10/2002	Ethoprop	0	0.03	ug/L	blank	
6/10/2002	Naled	0	0.02	ug/L	blank	
6/10/2002	Sulfotepp	0	0.01	ug/L	blank	
6/10/2002	Monocrotophos	0	0.01	ug/L	blank	
6/10/2002	Phorate	0	0.015	ug/L	blank	
6/10/2002	Dimethoate	0	0.05	ug/L	blank	
6/10/2002	Demeton,o-s	0	0.02	ug/L	blank	
6/10/2002	Diazinon	0	0.02	ug/L	blank	
6/10/2002	Disulfoton	0	0.015	ug/L	blank	
6/10/2002	Parathion,methyl	0	0.03	ug/L	blank	
6/10/2002	Ronnel	0	0.02	ug/L	blank	
6/10/2002	Chlorpyrifos	0	0.015	ug/L	blank	
6/10/2002	Malathion	0	0.02	ug/L	blank	
6/10/2002	Fenthion	0	0.01	ug/L	blank	
6/10/2002	Parathion	0	0.015	ug/L	blank	
6/10/2002	Trichloronate	0	0.01	ug/L	blank	
6/10/2002	Tetrachlorvinphos	0	0.01	ug/L	blank	
6/10/2002	Merphos	0	0.015	ug/L	blank	
6/10/2002	Tokuthion	0	0.015	ug/L	blank	
6/10/2002	Fensulfothion	0	0.015	ug/L	blank	
6/10/2002	Bolstar	0	0.01	ug/L	blank	
6/10/2002	EPN	0	0.01	ug/L	blank	
6/10/2002	Azinphos,methyl	0	0.015	ug/L	blank	
6/10/2002	Coumaphos	0	0.015	ug/L	blank	
6/10/2002	Tributyl Phosphate	68		%	bs	
6/10/2002	Triphenyl Phosphate	91.8		%	bs	
6/10/2002	Diazinon	0.645	0.02	ug/L	bs	
6/10/2002	Chlorpyrifos	0.853	0.015	ug/L	bs	
6/10/2002	Malathion	0.99	0.02	ug/L	bs	
6/10/2002	Azinphos,methyl	0.802	0.015	ug/L	bs	
6/10/2002	Tributyl Phosphate	85.5		%	bsd	
6/10/2002	Triphenyl Phosphate	89.5		%	bsd	
6/10/2002	Diazinon	0.897	0.02	ug/L	bsd	
6/10/2002	Chlorpyrifos	0.958	0.015	ug/L	bsd	
6/10/2002	Malathion	1.07	0.02	ug/L	bsd	
6/10/2002	Azinphos,methyl	0.88	0.015	ug/L	bsd	
6/10/2002	2,4-Dichlorophenylacetic acid	84.2		%	blank	
6/10/2002	Dalapon	0	0.05	ug/L	blank	
6/10/2002	4-Nitrophenol	0	0.05	ug/L	blank	
6/10/2002	Dicamba	0	0.05	ug/L	blank	
6/10/2002	Dichloroprop	0	0.05	ug/L	blank	
6/10/2002	2,4-D	0	0.05	ug/L	blank	

6/10/2002	Pentachlorophenol	0	0.05	ug/L	blank	
6/10/2002	Silvex (2,4,5-TP)	0	0.05	ug/L	blank	
6/10/2002	2,4,5-T	0	0.1	ug/L	blank	
6/10/2002	Dinoseb	0	0.05	ug/L	blank	
6/10/2002	2,4-DB	0	0.1	ug/L	blank	
6/10/2002	MCPP	0	0.05	ug/L	blank	
6/10/2002	MCPA	0	0.05	ug/L	blank	
6/10/2002	2,4-Dichlorophenylacetic acid	92.2		%	bs	
6/10/2002	Dalapon	2.59	0.05	ug/L	bs	
6/10/2002	Dicamba	3.79	0.05	ug/L	bs	
6/10/2002	2,4-D	4.29	0.05	ug/L	bs	
6/10/2002	Pentachlorophenol	4.18	0.05	ug/L	bs	
6/10/2002	Silvex (2,4,5-TP)	4.49	0.05	ug/L	bs	
6/10/2002	Dinoseb	3.97	0.05	ug/L	bs	
6/10/2002	MCPP	4.77	0.05	ug/L	bs	
6/10/2002	2,4-Dichlorophenylacetic acid	94.4		%	bsd	
6/10/2002	Dalapon	2.73	0.05	ug/L	bsd	
6/10/2002	Dicamba	3.9	0.05	ug/L	bsd	
6/10/2002	2,4-D	4.42	0.05	ug/L	bsd	
6/10/2002	Pentachlorophenol	4.36	0.05	ug/L	bsd	
6/10/2002	Silvex (2,4,5-TP)	4.81	0.05	ug/L	bsd	
6/10/2002	Dinoseb	4.53	0.05	ug/L	bsd	
6/10/2002	MCPP	5.11	0.05	ug/L	bsd	
6/10/2002	Nitrobenzene - d5	55.7		%	blank	
6/10/2002	2 - Fluorobiphenyl	50.1		%	blank	N
6/10/2002	p - Terphenyl - d14	72.5		%	blank	
6/10/2002	Naphthalene	0.00629	0.01	ug/L	blank	J B1
6/10/2002	2-Methylnaphthalene	0	0.1	ug/L	blank	
6/10/2002	2-Chloronaphthalene	0	0.01	ug/L	blank	
6/10/2002	Acenaphthylene	0	0.01	ug/L	blank	
6/10/2002	Acenaphthene	0	0.01	ug/L	blank	
6/10/2002	Fluorene	0	0.01	ug/L	blank	
6/10/2002	Phenanthrene	0.00307	0.01	ug/L	blank	J B1
6/10/2002	Anthracene	0	0.01	ug/L	blank	
6/10/2002	Fluoranthene	0	0.01	ug/L	blank	
6/10/2002	Pyrene	0	0.01	ug/L	blank	
6/10/2002	Benzo(a)anthracene	0	0.01	ug/L	blank	
6/10/2002	Chrysene	0	0.01	ug/L	blank	
6/10/2002	Benzofluoranthenes	0	0.02	ug/L	blank	
6/10/2002	Benzo(a)pyrene	0	0.01	ug/L	blank	
6/10/2002	Indeno(1,2,3-cd)pyrene	0	0.01	ug/L	blank	
6/10/2002	Dibenz(a,h)anthracene	0	0.01	ug/L	blank	
6/10/2002	Benzo(g,h,i)perylene	0	0.01	ug/L	blank	
6/10/2002	Atrazine	0	0.1	ug/L	blank	
6/10/2002	Nitrobenzene - d5	77		%	bs	
6/10/2002	2 - Fluorobiphenyl	60.5		%	bs	
6/10/2002	p - Terphenyl - d14	74.8		%	bs	
6/10/2002	Naphthalene	0.579	0.01	ug/L	bs	B2
6/10/2002	2-Methylnaphthalene	0.589	0.1	ug/L	bs	
6/10/2002	2-Chloronaphthalene	0.692	0.01	ug/L	bs	

	6/10/2002	Acenaphthylene	0.527	0.01	ug/L	bs	
	6/10/2002	Acenaphthene	0.647	0.01	ug/L	bs	
	6/10/2002	Fluorene	0.681	0.01	ug/L	bs	
	6/10/2002	Phenanthrene	0.675	0.01	ug/L	bs	B2
	6/10/2002	Anthracene	0.679	0.01	ug/L	bs	
	6/10/2002	Fluoranthene	0.727	0.01	ug/L	bs	
	6/10/2002	Pyrene	0.665	0.01	ug/L	bs	
	6/10/2002	Benzo(a)anthracene	0.806	0.01	ug/L	bs	
	6/10/2002	Chrysene	0.797	0.01	ug/L	bs	
	6/10/2002	Benzofluoranthenes	1.63	0.02	ug/L	bs	
	6/10/2002	Benzo(a)pyrene	0.694	0.01	ug/L	bs	
	6/10/2002	Indeno(1,2,3-cd)pyrene	1.16	0.01	ug/L	bs	
	6/10/2002	Dibenz(a,h)anthracene	1.27	0.01	ug/L	bs	
	6/10/2002	Benzo(g,h,i)perylene	1.2	0.01	ug/L	bs	
	6/10/2002	Atrazine	1.3	0.1	ug/L	bs	
	6/10/2002	Nitrobenzene - d5	78.5		%	bsd	
	6/10/2002	2 - Fluorobiphenyl	61.8		%	bsd	
	6/10/2002	p - Terphenyl - d14	76.5		%	bsd	
	6/10/2002	Naphthalene	0.65	0.01	ug/L	bsd	B2
	6/10/2002	2-Methylnaphthalene	0.651	0.1	ug/L	bsd	
	6/10/2002	2-Chloronaphthalene	0.707	0.01	ug/L	bsd	
	6/10/2002	Acenaphthylene	0.558	0.01	ug/L	bsd	
	6/10/2002	Acenaphthene	0.666	0.01	ug/L	bsd	
	6/10/2002	Fluorene	0.737	0.01	ug/L	bsd	
	6/10/2002	Phenanthrene	0.69	0.01	ug/L	bsd	B2
	6/10/2002	Anthracene	0.72	0.01	ug/L	bsd	
	6/10/2002	Fluoranthene	0.731	0.01	ug/L	bsd	
	6/10/2002	Pyrene	0.736	0.01	ug/L	bsd	
	6/10/2002	Benzo(a)anthracene	0.898	0.01	ug/L	bsd	
	6/10/2002	Chrysene	0.747	0.01	ug/L	bsd	
	6/10/2002	Benzofluoranthenes	1.74	0.02	ug/L	bsd	
	6/10/2002	Benzo(a)pyrene	0.742	0.01	ug/L	bsd	
	6/10/2002	Indeno(1,2,3-cd)pyrene	1.22	0.01	ug/L	bsd	
	6/10/2002	Dibenz(a,h)anthracene	1.33	0.01	ug/L	bsd	
	6/10/2002	Benzo(g,h,i)perylene	1.25	0.01	ug/L	bsd	
	6/10/2002	Atrazine	1.19	0.1	ug/L	bsd	
	6/6/2002	Fluoride	0	0.06	mg/L	blank	
	6/6/2002	Chloride	0	0.3	mg/L	blank	
	6/6/2002	Nitrite as N	0	0.031	mg/L	blank	
	6/6/2002	Nitrate as N	0	0.03	mg/L	blank	
	6/6/2002	Sulfate	0	0.3	mg/L	blank	
	6/6/2002	Fluoride	8.06	0.06	mg/L	bs	
	6/6/2002	Chloride	38.4	0.3	mg/L	bs	
	6/6/2002	Nitrite as N	2.07	0.031	mg/L	bs	
	6/6/2002	Nitrate as N	3.96	0.03	mg/L	bs	
	6/6/2002	Sulfate	40.2	0.3	mg/L	bs	
	6/13/2002	TOC	0	0.5	mg/L	blank	
CUGRDS4	6/10/2002	BOD(5day)	0	4	mg/L	sample	
CUGRHB2	6/10/2002	BOD(5day)	0	4	mg/L	sample	
CUGRDS4	6/5/2002	COLOR	20	5	COLOR	sample	

CUGRHB2	6/5/2002	COLOR	5	5	COLOR	sample	
CUGRDS4	6/7/2002	COND	32	10	umhos/cm	sample	
CUGRHB2	6/7/2002	COND	39	10	umhos/cm	sample	
CUGRDS4	6/13/2002	CYANIDE	0	0.05	mg/L	sample	
CUGRHB2	6/13/2002	CYANIDE	0	0.05	mg/L	sample	
CUGRDS4	6/5/2002	FECAL COLF	4	2	CFU/100ML	sample	
CUGRHB2	6/5/2002	FECAL COLF	34	2	CFU/100ML	sample	
CUGRDS4	6/11/2002	HARDNESS	15	5	mg/L	sample	
CUGRHB2	6/11/2002	HARDNESS	16	5	mg/L	sample	
CUGRDS4	6/10/2002	TDS	51	10	mg/L	sample	
CUGRHB2	6/10/2002	TDS	40	10	mg/L	sample	
CUGRDS4	6/8/2002	TURB	19.4	0.2	NTU	sample	
CUGRHB2	6/8/2002	TURB	3.8	0.2	NTU	sample	
CUGRDS4	6/7/2002	Copper	0	0.01	mg/L	sample	
CUGRDS4	6/7/2002	Iron	0.548	0.1	mg/L	sample	
CUGRDS4	6/7/2002	Manganese	0.0207	0.01	mg/L	sample	
CUGRDS4	6/7/2002	Nickel	0	0.01	mg/L	sample	
CUGRDS4	6/7/2002	Sodium	2.75	1	mg/L	sample	B1
CUGRDS4	6/7/2002	Zinc	0.00446	0.01	mg/L	sample	J B1
CUGRHB2	6/7/2002	Copper	0	0.01	mg/L	sample	
CUGRHB2	6/7/2002	Copper	0	0.01	mg/L	dup	
CUGRHB2	6/7/2002	Copper	0.459	0.01	mg/L	ms	
CUGRDS4	6/10/2002	Arsenic	0.000625	0.001	mg/L	sample	J
CUGRDS4	6/10/2002	Antimony	0.000656	0.003	mg/L	sample	J B1
CUGRDS4	6/10/2002	Cadmium	0	0.0005	mg/L	sample	
CUGRDS4	6/10/2002	Lead	0.000143	0.0005	mg/L	sample	J B1
CUGRDS4	6/10/2002	Selenium	0	0.003	mg/L	sample	
CUGRDS4	6/10/2002	Silver	0.000103	0.0005	mg/L	sample	J B1
CUGRDS4	6/10/2002	Thallium	8.9e-005	0.0005	mg/L	sample	J
CUGRHB2	6/10/2002	Arsenic	0.000265	0.001	mg/L	sample	J
CUGRHB2	6/10/2002	Antimony	0.000764	0.003	mg/L	sample	J B1
CUGRHB2	6/10/2002	Cadmium	0	0.0005	mg/L	sample	
CUGRHB2	6/10/2002	Lead	0.000318	0.0005	mg/L	sample	J B1
CUGRHB2	6/10/2002	Selenium	0	0.003	mg/L	sample	
CUGRHB2	6/10/2002	Silver	0.000262	0.0005	mg/L	sample	J B1
CUGRHB2	6/10/2002	Thallium	2.6e-005	0.0005	mg/L	sample	J
CUGRDS4	6/12/2002	Mercury	0	0.0002	mg/L	sample	
CUGRHB2	6/12/2002	Mercury	0	0.0002	mg/L	sample	
CUGRDS4	6/7/2002	Barium	0.00445	0.005	mg/L	sample	J
CUGRDS4	6/7/2002	Beryllium	0	0.002	mg/L	sample	
CUGRDS4	6/7/2002	Chromium	0.000641	0.01	mg/L	sample	J
CUGRDS4	6/14/2002	Tetrachloro-m-xylene	75.6		%	sample	
CUGRDS4	6/14/2002	Decachlorobiphenyl	90.2		%	sample	
CUGRDS4	6/14/2002	Aldrin	0	0.00102	ug/L	sample	
CUGRDS4	6/14/2002	alpha-BHC	0	0.00102	ug/L	sample	
CUGRDS4	6/14/2002	beta-BHC	0	0.00102	ug/L	sample	
CUGRDS4	6/14/2002	delta-BHC	0	0.00102	ug/L	sample	
CUGRDS4	6/14/2002	gamma-BHC (Lindane)	0	0.00102	ug/L	sample	
CUGRDS4	6/14/2002	Chlordane (technical)	0	0.0102	ug/L	sample	
CUGRDS4	6/14/2002	4,4'-DDD	0	0.00204	ug/L	sample	

CUGRDS4	6/14/2002	4,4'-DDE	0	0.00204	ug/L	sample
CUGRDS4	6/14/2002	4,4'-DDT	0	0.00204	ug/L	sample
CUGRDS4	6/14/2002	Dieldrin	0	0.00204	ug/L	sample
CUGRDS4	6/14/2002	Endosulfan I	0	0.00102	ug/L	sample
CUGRDS4	6/14/2002	Endosulfan II	0	0.00204	ug/L	sample
CUGRDS4	6/14/2002	Endosulfan sulfate	0	0.00204	ug/L	sample
CUGRDS4	6/14/2002	Endrin	0	0.00204	ug/L	sample
CUGRDS4	6/14/2002	Endrin aldehyde	0	0.00204	ug/L	sample
CUGRDS4	6/14/2002	Heptachlor	0	0.00102	ug/L	sample
CUGRDS4	6/14/2002	Heptachlor epoxide	0	0.00102	ug/L	sample
CUGRDS4	6/14/2002	Methoxychlor	0	0.0102	ug/L	sample
CUGRDS4	6/14/2002	Endrin ketone	0	0.00204	ug/L	sample
CUGRDS4	6/14/2002	Toxaphene	0	0.102	ug/L	sample
CUGRHB2	6/14/2002	Tetrachloro-m-xylene	78.9		%	sample
CUGRHB2	6/14/2002	Decachlorobiphenyl	91.2		%	sample
CUGRHB2	6/14/2002	Aldrin	0	0.000956	ug/L	sample
CUGRHB2	6/14/2002	alpha-BHC	0	0.000956	ug/L	sample
CUGRHB2	6/14/2002	beta-BHC	0	0.000956	ug/L	sample
CUGRHB2	6/14/2002	delta-BHC	0	0.000956	ug/L	sample
CUGRHB2	6/14/2002	gamma-BHC (Lindane)	0	0.000956	ug/L	sample
CUGRHB2	6/14/2002	Chlordane (technical)	0	0.00956	ug/L	sample
CUGRHB2	6/14/2002	4,4'-DDD	0	0.00191	ug/L	sample
CUGRHB2	6/14/2002	4,4'-DDE	0	0.00191	ug/L	sample
CUGRHB2	6/14/2002	4,4'-DDT	0	0.00191	ug/L	sample
CUGRHB2	6/14/2002	Dieldrin	0	0.00191	ug/L	sample
CUGRHB2	6/14/2002	Endosulfan I	0	0.000956	ug/L	sample
CUGRHB2	6/14/2002	Endosulfan II	0	0.00191	ug/L	sample
CUGRHB2	6/14/2002	Endosulfan sulfate	0	0.00191	ug/L	sample
CUGRHB2	6/14/2002	Endrin	0	0.00191	ug/L	sample
CUGRHB2	6/14/2002	Endrin aldehyde	0	0.00191	ug/L	sample
CUGRHB2	6/14/2002	Heptachlor	0	0.000956	ug/L	sample
CUGRHB2	6/14/2002	Heptachlor epoxide	0	0.000956	ug/L	sample
CUGRHB2	6/14/2002	Methoxychlor	0	0.00956	ug/L	sample
CUGRHB2	6/14/2002	Endrin ketone	0	0.00191	ug/L	sample
CUGRHB2	6/14/2002	Toxaphene	0	0.0956	ug/L	sample
CUGRDS4	6/10/2002	Tributyl Phosphate	89.7		%	sample
CUGRDS4	6/10/2002	Triphenyl Phosphate	84.2		%	sample
CUGRDS4	6/10/2002	Dichlorvos	0	0.0198	ug/L	sample
CUGRDS4	6/10/2002	Mevinphos	0	0.0198	ug/L	sample
CUGRDS4	6/10/2002	Ethoprop	0	0.0297	ug/L	sample
CUGRDS4	6/10/2002	Naled	0	0.0198	ug/L	sample
CUGRDS4	6/10/2002	Sulfotepp	0	0.0099	ug/L	sample
CUGRDS4	6/10/2002	Monocrotophos	0	0.0099	ug/L	sample
CUGRDS4	6/10/2002	Phorate	0	0.0149	ug/L	sample
CUGRDS4	6/10/2002	Dimethoate	0	0.0495	ug/L	sample
CUGRDS4	6/10/2002	Demeton,o-s	0	0.0198	ug/L	sample
CUGRDS4	6/10/2002	Diazinon	0	0.0198	ug/L	sample
CUGRDS4	6/10/2002	Disulfoton	0	0.0149	ug/L	sample
CUGRDS4	6/10/2002	Parathion,methyl	0	0.0297	ug/L	sample
CUGRDS4	6/10/2002	Ronnel	0	0.0198	ug/L	sample

CUGRDS4	6/10/2002	Chlorpyrifos	0	0.0149	ug/L	sample
CUGRDS4	6/10/2002	Malathion	0	0.0198	ug/L	sample
CUGRDS4	6/10/2002	Fenthion	0	0.0099	ug/L	sample
CUGRDS4	6/10/2002	Parathion	0	0.0149	ug/L	sample
CUGRDS4	6/10/2002	Trichloronate	0	0.0099	ug/L	sample
CUGRDS4	6/10/2002	Tetrachlorvinphos	0	0.0099	ug/L	sample
CUGRDS4	6/10/2002	Merphos	0	0.0149	ug/L	sample
CUGRDS4	6/10/2002	Tokuthion	0	0.0149	ug/L	sample
CUGRDS4	6/10/2002	Fensulfothion	0	0.0149	ug/L	sample
CUGRDS4	6/10/2002	Bolstar	0	0.0099	ug/L	sample
CUGRDS4	6/10/2002	EPN	0	0.0099	ug/L	sample
CUGRDS4	6/10/2002	Azinphos,methyl	0	0.0149	ug/L	sample
CUGRDS4	6/10/2002	Coumaphos	0	0.0149	ug/L	sample
CUGRHB2	6/10/2002	Tributyl Phosphate	96.5		%	sample
CUGRHB2	6/10/2002	Triphenyl Phosphate	90.7		%	sample
CUGRHB2	6/10/2002	Dichlorvos	0	0.019	ug/L	sample
CUGRHB2	6/10/2002	Mevinphos	0	0.019	ug/L	sample
CUGRHB2	6/10/2002	Ethoprop	0	0.0285	ug/L	sample
CUGRHB2	6/10/2002	Naled	0	0.019	ug/L	sample
CUGRHB2	6/10/2002	Sulfotepp	0	0.00951	ug/L	sample
CUGRHB2	6/10/2002	Monocrotophos	0	0.00951	ug/L	sample
CUGRHB2	6/10/2002	Phorate	0	0.0143	ug/L	sample
CUGRHB2	6/10/2002	Dimethoate	0	0.0476	ug/L	sample
CUGRHB2	6/10/2002	Demeton,o-s	0	0.019	ug/L	sample
CUGRHB2	6/10/2002	Diazinon	0	0.019	ug/L	sample
CUGRHB2	6/10/2002	Disulfoton	0	0.0143	ug/L	sample
CUGRHB2	6/10/2002	Parathion,methyl	0	0.0285	ug/L	sample
CUGRHB2	6/10/2002	Ronnel	0	0.019	ug/L	sample
CUGRHB2	6/10/2002	Chlorpyrifos	0	0.0143	ug/L	sample
CUGRHB2	6/10/2002	Malathion	0	0.019	ug/L	sample
CUGRHB2	6/10/2002	Fenthion	0	0.00951	ug/L	sample
CUGRHB2	6/10/2002	Parathion	0	0.0143	ug/L	sample
CUGRHB2	6/10/2002	Trichloronate	0	0.00951	ug/L	sample
CUGRHB2	6/10/2002	Tetrachlorvinphos	0	0.00951	ug/L	sample
CUGRHB2	6/10/2002	Merphos	0	0.0143	ug/L	sample
CUGRHB2	6/10/2002	Tokuthion	0	0.0143	ug/L	sample
CUGRHB2	6/10/2002	Fensulfothion	0	0.0143	ug/L	sample
CUGRHB2	6/10/2002	Bolstar	0	0.00951	ug/L	sample
CUGRHB2	6/10/2002	EPN	0	0.00951	ug/L	sample
CUGRHB2	6/10/2002	Azinphos,methyl	0	0.0143	ug/L	sample
CUGRHB2	6/10/2002	Coumaphos	0	0.0143	ug/L	sample
CUGRDS4	6/10/2002	2,4-Dichlorophenylacetic acid	101		%	sample
CUGRDS4	6/10/2002	Dalapon	0	0.0497	ug/L	sample
CUGRDS4	6/10/2002	4-Nitrophenol	0	0.0497	ug/L	sample
CUGRDS4	6/10/2002	Dicamba	0	0.0497	ug/L	sample
CUGRDS4	6/10/2002	Dichloroprop	0	0.0497	ug/L	sample
CUGRDS4	6/10/2002	2,4-D	0	0.0497	ug/L	sample
CUGRDS4	6/10/2002	Pentachlorophenol	0	0.0497	ug/L	sample
CUGRDS4	6/10/2002	Silvex (2,4,5-TP)	0	0.0497	ug/L	sample
CUGRDS4	6/10/2002	2,4,5-T	0	0.0994	ug/L	sample

CUGRDS4	6/10/2002	Dinoseb	0	0.0497	ug/L	sample	
CUGRDS4	6/10/2002	2,4-DB	0	0.0994	ug/L	sample	
CUGRDS4	6/10/2002	MCPP	0	0.0497	ug/L	sample	
CUGRDS4	6/10/2002	MCPA	0	0.0497	ug/L	sample	
CUGRHB2	6/10/2002	2,4-Dichlorophenylacetic acid	102		%	sample	
CUGRHB2	6/10/2002	Dalapon	0	0.0479	ug/L	sample	
CUGRHB2	6/10/2002	4-Nitrophenol	0	0.0479	ug/L	sample	
CUGRHB2	6/10/2002	Dicamba	0	0.0479	ug/L	sample	
CUGRHB2	6/10/2002	Dichloroprop	0	0.0479	ug/L	sample	
CUGRHB2	6/10/2002	2,4-D	0	0.0479	ug/L	sample	
CUGRHB2	6/10/2002	Pentachlorophenol	0	0.0479	ug/L	sample	
CUGRHB2	6/10/2002	Silvex (2,4,5-TP)	0	0.0479	ug/L	sample	
CUGRHB2	6/10/2002	2,4,5-T	0	0.0958	ug/L	sample	
CUGRHB2	6/10/2002	Dinoseb	0	0.0479	ug/L	sample	
CUGRHB2	6/10/2002	2,4-DB	0	0.0958	ug/L	sample	
CUGRHB2	6/10/2002	MCPP	0	0.0479	ug/L	sample	
CUGRHB2	6/10/2002	MCPA	0	0.0479	ug/L	sample	
CUGRDS4	6/10/2002	Nitrobenzene - d5	64.5		%	sample	
CUGRDS4	6/10/2002	2 - Fluorobiphenyl	59.3		%	sample	
CUGRDS4	6/10/2002	p - Terphenyl - d14	74.7		%	sample	
CUGRDS4	6/10/2002	Naphthalene	0	0.00982	ug/L	sample	
CUGRDS4	6/10/2002	2-Methylnaphthalene	0	0.0982	ug/L	sample	
CUGRDS4	6/10/2002	2-Chloronaphthalene	0	0.00982	ug/L	sample	
CUGRDS4	6/10/2002	Acenaphthylene	0	0.00982	ug/L	sample	
CUGRDS4	6/10/2002	Acenaphthene	0	0.00982	ug/L	sample	
CUGRDS4	6/10/2002	Fluorene	0	0.00982	ug/L	sample	
CUGRDS4	6/10/2002	Phenanthrene	0	0.00982	ug/L	sample	
CUGRDS4	6/10/2002	Anthracene	0	0.00982	ug/L	sample	
CUGRDS4	6/10/2002	Fluoranthene	0	0.00982	ug/L	sample	
CUGRDS4	6/10/2002	Pyrene	0	0.00982	ug/L	sample	
CUGRDS4	6/10/2002	Benzo(a)anthracene	0	0.00982	ug/L	sample	
CUGRDS4	6/10/2002	Chrysene	0	0.00982	ug/L	sample	
CUGRDS4	6/10/2002	Benzofluoranthenes	0	0.0196	ug/L	sample	
CUGRDS4	6/10/2002	Benzo(a)pyrene	0	0.00982	ug/L	sample	
CUGRDS4	6/10/2002	Indeno(1,2,3-cd)pyrene	0	0.00982	ug/L	sample	
CUGRDS4	6/10/2002	Dibenz(a,h)anthracene	0	0.00982	ug/L	sample	
CUGRDS4	6/10/2002	Benzo(g,h,i)perylene	0	0.00982	ug/L	sample	
CUGRDS4	6/10/2002	Atrazine	0	0.0982	ug/L	sample	
CUGRHB2	6/10/2002	Nitrobenzene - d5	66.9		%	sample	
CUGRHB2	6/10/2002	2 - Fluorobiphenyl	54.8		%	sample	N
CUGRHB2	6/10/2002	p - Terphenyl - d14	78.1		%	sample	
CUGRHB2	6/10/2002	Naphthalene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	2-Methylnaphthalene	0	0.0955	ug/L	sample	
CUGRHB2	6/10/2002	2-Chloronaphthalene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	Acenaphthylene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	Acenaphthene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	Fluorene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	Phenanthrene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	Anthracene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	Fluoranthene	0	0.00955	ug/L	sample	

CUGRHB2	6/10/2002	Pyrene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	Benzo(a)anthracene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	Chrysene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	Benzofluoranthenes	0	0.0191	ug/L	sample	
CUGRHB2	6/10/2002	Benzo(a)pyrene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	Indeno(1,2,3-cd)pyrene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	Dibenz(a,h)anthracene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	Benzo(g,h,i)perylene	0	0.00955	ug/L	sample	
CUGRHB2	6/10/2002	Atrazine	0	0.0955	ug/L	sample	
CUGRDS4	6/6/2002	Fluoride	0	0.06	mg/L	sample	
CUGRDS4	6/6/2002	Chloride	0.368	0.3	mg/L	sample	
CUGRDS4	6/6/2002	Nitrite as N	0	0.031	mg/L	sample	
CUGRDS4	6/6/2002	Nitrate as N	0.017	0.03	mg/L	sample	J
CUGRDS4	6/6/2002	Sulfate	0.237	0.3	mg/L	sample	J
CUGRHB2	6/6/2002	Fluoride	0	0.06	mg/L	sample	
CUGRHB2	6/6/2002	Chloride	0.683	0.3	mg/L	sample	
CUGRHB2	6/6/2002	Nitrite as N	0	0.031	mg/L	sample	
CUGRHB2	6/6/2002	Nitrate as N	0	0.03	mg/L	sample	
CUGRHB2	6/6/2002	Sulfate	0.546	0.3	mg/L	sample	
CUGRDS4	6/6/2002	Fluoride	0	0.06	mg/L	dup	
CUGRDS4	6/6/2002	Chloride	0.368	0.3	mg/L	dup	
CUGRDS4	6/6/2002	Nitrite as N	0	0.031	mg/L	dup	
CUGRDS4	6/6/2002	Nitrate as N	0.017	0.03	mg/L	dup	J
CUGRDS4	6/6/2002	Sulfate	0.266	0.3	mg/L	dup	J
CUGRDS4	6/6/2002	Fluoride	7.98	0.0606	mg/L	ms	
CUGRDS4	6/6/2002	Chloride	40.2	0.303	mg/L	ms	
CUGRDS4	6/6/2002	Nitrite as N	2.05	0.0313	mg/L	ms	
CUGRDS4	6/6/2002	Nitrate as N	4.05	0.0303	mg/L	ms	
CUGRDS4	6/6/2002	Sulfate	41.1	0.303	mg/L	ms	
CUGRDS4	6/13/2002	TOC	1.76	0.5	mg/L	sample	
CUGRHB2	6/13/2002	TOC	1.36	0.5	mg/L	sample	
CUGRDS4	6/13/2002	TOC	12	0.5	mg/L	ms	
CUGRDS4	6/13/2002	TOC	12.2	0.5	mg/L	msd	
	6/7/2002	Barium	0	0.005	mg/L	blank	
	6/7/2002	Beryllium	0	0.002	mg/L	blank	
	6/7/2002	Chromium	0	0.01	mg/L	blank	
	6/7/2002	Copper	0	0.01	mg/L	blank	
	6/7/2002	Iron	0	0.1	mg/L	blank	
	6/7/2002	Manganese	0	0.01	mg/L	blank	
	6/7/2002	Nickel	0	0.01	mg/L	blank	
	6/7/2002	Sodium	0.647	1	mg/L	blank	J
	6/7/2002	Zinc	0.0012	0.01	mg/L	blank	J
	6/12/2002	Mercury	0	0.0002	mg/L	blank	
	6/13/2002	Tetrachloro-m-xylene	68.4		%	blank	N
	6/13/2002	Decachlorobiphenyl	80.7		%	blank	
	6/13/2002	Aldrin	0	0.001	ug/L	blank	
	6/13/2002	alpha-BHC	0	0.001	ug/L	blank	
	6/13/2002	beta-BHC	0	0.001	ug/L	blank	
	6/13/2002	delta-BHC	0	0.001	ug/L	blank	
	6/13/2002	gamma-BHC (Lindane)	0	0.001	ug/L	blank	

6/13/2002	Chlordane (technical)	0	0.01	ug/L	blank	
6/13/2002	4,4'-DDD	0	0.002	ug/L	blank	
6/13/2002	4,4'-DDE	0	0.002	ug/L	blank	
6/13/2002	4,4'-DDT	0	0.002	ug/L	blank	
6/13/2002	Dieldrin	0	0.002	ug/L	blank	
6/13/2002	Endosulfan I	0	0.001	ug/L	blank	
6/13/2002	Endosulfan II	0	0.002	ug/L	blank	
6/13/2002	Endosulfan sulfate	0	0.002	ug/L	blank	
6/13/2002	Endrin	0	0.002	ug/L	blank	
6/13/2002	Endrin aldehyde	0	0.002	ug/L	blank	
6/13/2002	Heptachlor	0	0.001	ug/L	blank	
6/13/2002	Heptachlor epoxide	0	0.001	ug/L	blank	
6/13/2002	Methoxychlor	0	0.01	ug/L	blank	
6/13/2002	Endrin ketone	0	0.002	ug/L	blank	
6/13/2002	Toxaphene	0	0.1	ug/L	blank	
6/13/2002	Tetrachloro-m-xylene	77		%	bs	
6/13/2002	Decachlorobiphenyl	90.8		%	bs	
6/13/2002	Aldrin	0.017	0.001	ug/L	bs	C1
6/13/2002	gamma-BHC (Lindane)	0.0176	0.001	ug/L	bs	C1
6/13/2002	4,4'-DDT	0.0457	0.002	ug/L	bs	C1
6/13/2002	Dieldrin	0.0414	0.002	ug/L	bs	C1
6/13/2002	Endrin	0.0369	0.002	ug/L	bs	C1
6/13/2002	Heptachlor	0.0162	0.001	ug/L	bs	C1
6/14/2002	Tetrachloro-m-xylene	77.6		%	bsd	
6/14/2002	Decachlorobiphenyl	88.7		%	bsd	
6/14/2002	Aldrin	0.0197	0.001	ug/L	bsd	C1
6/14/2002	gamma-BHC (Lindane)	0.0192	0.001	ug/L	bsd	C1
6/14/2002	4,4'-DDT	0.0477	0.002	ug/L	bsd	C1
6/14/2002	Dieldrin	0.0454	0.002	ug/L	bsd	C1
6/14/2002	Endrin	0.0404	0.002	ug/L	bsd	C1
6/14/2002	Heptachlor	0.0184	0.001	ug/L	bsd	C1
6/10/2002	Tributyl Phosphate	76.7		%	blank	
6/10/2002	Triphenyl Phosphate	86.1		%	blank	
6/10/2002	Dichlorvos	0	0.02	ug/L	blank	
6/10/2002	Mevinphos	0	0.02	ug/L	blank	
6/10/2002	Ethoprop	0	0.03	ug/L	blank	
6/10/2002	Naled	0	0.02	ug/L	blank	
6/10/2002	Sulfotepp	0	0.01	ug/L	blank	
6/10/2002	Monocrotophos	0	0.01	ug/L	blank	
6/10/2002	Phorate	0	0.015	ug/L	blank	
6/10/2002	Dimethoate	0	0.05	ug/L	blank	
6/10/2002	Demeton,o-s	0	0.02	ug/L	blank	
6/10/2002	Diazinon	0	0.02	ug/L	blank	
6/10/2002	Disulfoton	0	0.015	ug/L	blank	
6/10/2002	Parathion,methyl	0	0.03	ug/L	blank	
6/10/2002	Ronnel	0	0.02	ug/L	blank	
6/10/2002	Chlorpyrifos	0	0.015	ug/L	blank	
6/10/2002	Malathion	0	0.02	ug/L	blank	
6/10/2002	Fenthion	0	0.01	ug/L	blank	
6/10/2002	Parathion	0	0.015	ug/L	blank	

6/10/2002	Trichloronate	0	0.01	ug/L	blank
6/10/2002	Tetrachlorvinphos	0	0.01	ug/L	blank
6/10/2002	Merphos	0	0.015	ug/L	blank
6/10/2002	Tokuthion	0	0.015	ug/L	blank
6/10/2002	Fensulfothion	0	0.015	ug/L	blank
6/10/2002	Bolstar	0	0.01	ug/L	blank
6/10/2002	EPN	0	0.01	ug/L	blank
6/10/2002	Azinphos,methyl	0	0.015	ug/L	blank
6/10/2002	Coumaphos	0	0.015	ug/L	blank
6/10/2002	Tributyl Phosphate	68		%	bs
6/10/2002	Triphenyl Phosphate	91.8		%	bs
6/10/2002	Diazinon	0.645	0.02	ug/L	bs
6/10/2002	Chlorpyrifos	0.853	0.015	ug/L	bs
6/10/2002	Malathion	0.99	0.02	ug/L	bs
6/10/2002	Azinphos,methyl	0.802	0.015	ug/L	bs
6/10/2002	Tributyl Phosphate	85.5		%	bsd
6/10/2002	Triphenyl Phosphate	89.5		%	bsd
6/10/2002	Diazinon	0.897	0.02	ug/L	bsd
6/10/2002	Chlorpyrifos	0.958	0.015	ug/L	bsd
6/10/2002	Malathion	1.07	0.02	ug/L	bsd
6/10/2002	Azinphos,methyl	0.88	0.015	ug/L	bsd
6/10/2002	2,4-Dichlorophenylacetic acid	84.2		%	blank
6/10/2002	Dalapon	0	0.05	ug/L	blank
6/10/2002	4-Nitrophenol	0	0.05	ug/L	blank
6/10/2002	Dicamba	0	0.05	ug/L	blank
6/10/2002	Dichloroprop	0	0.05	ug/L	blank
6/10/2002	2,4-D	0	0.05	ug/L	blank
6/10/2002	Pentachlorophenol	0	0.05	ug/L	blank
6/10/2002	Silvex (2,4,5-TP)	0	0.05	ug/L	blank
6/10/2002	2,4,5-T	0	0.1	ug/L	blank
6/10/2002	Dinoseb	0	0.05	ug/L	blank
6/10/2002	2,4-DB	0	0.1	ug/L	blank
6/10/2002	MCPP	0	0.05	ug/L	blank
6/10/2002	MCPA	0	0.05	ug/L	blank
6/10/2002	2,4-Dichlorophenylacetic acid	92.2		%	bs
6/10/2002	Dalapon	2.59	0.05	ug/L	bs
6/10/2002	Dicamba	3.79	0.05	ug/L	bs
6/10/2002	2,4-D	4.29	0.05	ug/L	bs
6/10/2002	Pentachlorophenol	4.18	0.05	ug/L	bs
6/10/2002	Silvex (2,4,5-TP)	4.49	0.05	ug/L	bs
6/10/2002	Dinoseb	3.97	0.05	ug/L	bs
6/10/2002	MCPP	4.77	0.05	ug/L	bs
6/10/2002	2,4-Dichlorophenylacetic acid	94.4		%	bsd
6/10/2002	Dalapon	2.73	0.05	ug/L	bsd
6/10/2002	Dicamba	3.9	0.05	ug/L	bsd
6/10/2002	2,4-D	4.42	0.05	ug/L	bsd
6/10/2002	Pentachlorophenol	4.36	0.05	ug/L	bsd
6/10/2002	Silvex (2,4,5-TP)	4.81	0.05	ug/L	bsd
6/10/2002	Dinoseb	4.53	0.05	ug/L	bsd
6/10/2002	MCPP	5.11	0.05	ug/L	bsd

6/10/2002	Nitrobenzene - d5	55.7		%	blank	
6/10/2002	2 - Fluorobiphenyl	50.1		%	blank	N
6/10/2002	p - Terphenyl - d14	72.5		%	blank	
6/10/2002	Naphthalene	0.00629	0.01	ug/L	blank	J B1
6/10/2002	2-Methylnaphthalene	0	0.1	ug/L	blank	
6/10/2002	2-Chloronaphthalene	0	0.01	ug/L	blank	
6/10/2002	Acenaphthylene	0	0.01	ug/L	blank	
6/10/2002	Acenaphthene	0	0.01	ug/L	blank	
6/10/2002	Fluorene	0	0.01	ug/L	blank	
6/10/2002	Phenanthrene	0.00307	0.01	ug/L	blank	J B1
6/10/2002	Anthracene	0	0.01	ug/L	blank	
6/10/2002	Fluoranthene	0	0.01	ug/L	blank	
6/10/2002	Pyrene	0	0.01	ug/L	blank	
6/10/2002	Benzo(a)anthracene	0	0.01	ug/L	blank	
6/10/2002	Chrysene	0	0.01	ug/L	blank	
6/10/2002	Benzofluoranthenes	0	0.02	ug/L	blank	
6/10/2002	Benzo(a)pyrene	0	0.01	ug/L	blank	
6/10/2002	Indeno(1,2,3-cd)pyrene	0	0.01	ug/L	blank	
6/10/2002	Dibenz(a,h)anthracene	0	0.01	ug/L	blank	
6/10/2002	Benzo(g,h,i)perylene	0	0.01	ug/L	blank	
6/10/2002	Atrazine	0	0.1	ug/L	blank	
6/10/2002	Nitrobenzene - d5	77		%	bs	
6/10/2002	2 - Fluorobiphenyl	60.5		%	bs	
6/10/2002	p - Terphenyl - d14	74.8		%	bs	
6/10/2002	Naphthalene	0.579	0.01	ug/L	bs	B2
6/10/2002	2-Methylnaphthalene	0.589	0.1	ug/L	bs	
6/10/2002	2-Chloronaphthalene	0.692	0.01	ug/L	bs	
6/10/2002	Acenaphthylene	0.527	0.01	ug/L	bs	
6/10/2002	Acenaphthene	0.647	0.01	ug/L	bs	
6/10/2002	Fluorene	0.681	0.01	ug/L	bs	
6/10/2002	Phenanthrene	0.675	0.01	ug/L	bs	B2
6/10/2002	Anthracene	0.679	0.01	ug/L	bs	
6/10/2002	Fluoranthene	0.727	0.01	ug/L	bs	
6/10/2002	Pyrene	0.665	0.01	ug/L	bs	
6/10/2002	Benzo(a)anthracene	0.806	0.01	ug/L	bs	
6/10/2002	Chrysene	0.797	0.01	ug/L	bs	
6/10/2002	Benzofluoranthenes	1.63	0.02	ug/L	bs	
6/10/2002	Benzo(a)pyrene	0.694	0.01	ug/L	bs	
6/10/2002	Indeno(1,2,3-cd)pyrene	1.16	0.01	ug/L	bs	
6/10/2002	Dibenz(a,h)anthracene	1.27	0.01	ug/L	bs	
6/10/2002	Benzo(g,h,i)perylene	1.2	0.01	ug/L	bs	
6/10/2002	Atrazine	1.3	0.1	ug/L	bs	
6/10/2002	Nitrobenzene - d5	78.5		%	bsd	
6/10/2002	2 - Fluorobiphenyl	61.8		%	bsd	
6/10/2002	p - Terphenyl - d14	76.5		%	bsd	
6/10/2002	Naphthalene	0.65	0.01	ug/L	bsd	B2
6/10/2002	2-Methylnaphthalene	0.651	0.1	ug/L	bsd	
6/10/2002	2-Chloronaphthalene	0.707	0.01	ug/L	bsd	
6/10/2002	Acenaphthylene	0.558	0.01	ug/L	bsd	
6/10/2002	Acenaphthene	0.666	0.01	ug/L	bsd	

	6/10/2002	Fluorene	0.737	0.01	ug/L	bsd	
	6/10/2002	Phenanthrene	0.69	0.01	ug/L	bsd	B2
	6/10/2002	Anthracene	0.72	0.01	ug/L	bsd	
	6/10/2002	Fluoranthene	0.731	0.01	ug/L	bsd	
	6/10/2002	Pyrene	0.736	0.01	ug/L	bsd	
	6/10/2002	Benzo(a)anthracene	0.898	0.01	ug/L	bsd	
	6/10/2002	Chrysene	0.747	0.01	ug/L	bsd	
	6/10/2002	Benzofluoranthenes	1.74	0.02	ug/L	bsd	
	6/10/2002	Benzo(a)pyrene	0.742	0.01	ug/L	bsd	
	6/10/2002	Indeno(1,2,3-cd)pyrene	1.22	0.01	ug/L	bsd	
	6/10/2002	Dibenz(a,h)anthracene	1.33	0.01	ug/L	bsd	
	6/10/2002	Benzo(g,h,i)perylene	1.25	0.01	ug/L	bsd	
	6/10/2002	Atrazine	1.19	0.1	ug/L	bsd	
	6/6/2002	Fluoride	0	0.06	mg/L	blank	
	6/6/2002	Chloride	0	0.3	mg/L	blank	
	6/6/2002	Nitrite as N	0	0.031	mg/L	blank	
	6/6/2002	Nitrate as N	0	0.03	mg/L	blank	
	6/6/2002	Sulfate	0	0.3	mg/L	blank	
	6/6/2002	Fluoride	8.06	0.06	mg/L	bs	
	6/6/2002	Chloride	38.4	0.3	mg/L	bs	
	6/6/2002	Nitrite as N	2.07	0.031	mg/L	bs	
	6/6/2002	Nitrate as N	3.96	0.03	mg/L	bs	
	6/6/2002	Sulfate	40.2	0.3	mg/L	bs	
	6/13/2002	TOC	0	0.5	mg/L	blank	
CUGRDS4	6/10/2002	BOD(5day)	0	4	mg/L	sample	
CUGRHB2	6/10/2002	BOD(5day)	0	4	mg/L	sample	
CUGRDS4	6/5/2002	COLOR	20	5	COLOR	sample	
CUGRHB2	6/5/2002	COLOR	5	5	COLOR	sample	
CUGRDS4	6/7/2002	COND	32	10	umhos/cm	sample	
CUGRHB2	6/7/2002	COND	39	10	umhos/cm	sample	
CUGRDS4	6/13/2002	CYANIDE	0	0.05	mg/L	sample	
CUGRHB2	6/13/2002	CYANIDE	0	0.05	mg/L	sample	
CUGRDS4	6/5/2002	FECAL COLF	4	2	CFU/100ML	sample	
CUGRHB2	6/5/2002	FECAL COLF	34	2	CFU/100ML	sample	
CUGRDS4	6/11/2002	HARDNESS	15	5	mg/L	sample	
CUGRHB2	6/11/2002	HARDNESS	16	5	mg/L	sample	
CUGRDS4	6/10/2002	TDS	51	10	mg/L	sample	
CUGRHB2	6/10/2002	TDS	40	10	mg/L	sample	
CUGRDS4	6/8/2002	TURB	19.4	0.2	NTU	sample	
CUGRHB2	6/8/2002	TURB	3.8	0.2	NTU	sample	

Water samles collected 6/17/02 at the gage downstream of dam

(CUGRDS5) and at Hayden Bridge (CUGRHB3)

Client ID	Analyzed	Parameter	Result	PQL	Units	QC Type	Flags
CUGRDS5	6/21/2002	Iron	1.2	0.1	mg/L	sample	
CUGRDS5	6/21/2002	Sodium	2.04	1	mg/L	sample	
CUGRHB3	6/21/2002	Iron	0.108	0.1	mg/L	sample	
CUGRHB3	6/21/2002	Sodium	3.03	1	mg/L	sample	
CUGRDS5	6/21/2002	Iron	1.05	0.1	mg/L	dup	

CUGRDS5	6/21/2002	Sodium	2.06	1	mg/L	dup	
CUGRDS5	6/21/2002	Iron	21.6	0.1	mg/L	ms	
CUGRDS5	6/21/2002	Sodium	20.4	1	mg/L	ms	
CUGRDS5	6/21/2002	Cadmium	ND	0.005	mg/L	sample	
CUGRDS5	6/21/2002	Chromium	ND	0.01	mg/L	sample	
CUGRDS5	6/21/2002	Copper	ND	0.01	mg/L	sample	
CUGRDS5	6/21/2002	Lead	ND	0.01	mg/L	sample	
CUGRDS5	6/21/2002	Nickel	ND	0.01	mg/L	sample	
CUGRDS5	6/21/2002	Silver	ND	0.01	mg/L	sample	
CUGRDS5	6/21/2002	Zinc	0.0245	0.01	mg/L	sample	
CUGRDS5	6/21/2002	Cadmium	ND	0.005	mg/L	dup	
CUGRDS5	6/21/2002	Chromium	ND	0.01	mg/L	dup	
CUGRDS5	6/21/2002	Copper	ND	0.01	mg/L	dup	
CUGRDS5	6/21/2002	Lead	0.015	0.01	mg/L	dup	
CUGRDS5	6/21/2002	Nickel	ND	0.01	mg/L	dup	
CUGRDS5	6/21/2002	Silver	ND	0.01	mg/L	dup	
CUGRDS5	6/21/2002	Zinc	0.0256	0.01	mg/L	dup	
CUGRDS5	6/21/2002	Cadmium	0.0918	0.005	mg/L	ms	
CUGRDS5	6/21/2002	Chromium	0.378	0.01	mg/L	ms	
CUGRDS5	6/21/2002	Copper	0.435	0.01	mg/L	ms	
CUGRDS5	6/21/2002	Lead	0.907	0.01	mg/L	ms	
CUGRDS5	6/21/2002	Nickel	0.906	0.01	mg/L	ms	
CUGRDS5	6/21/2002	Silver	0.547	0.01	mg/L	ms	
CUGRDS5	6/21/2002	Zinc	0.911	0.01	mg/L	ms	
CUGRDS5	6/21/2002	Arsenic	0.000779	0.001	mg/L	sample	J
CUGRDS5	6/21/2002	Antimony	0.000134	0.003	mg/L	sample	J B1
CUGRDS5	6/21/2002	Barium	0.00702	0.001	mg/L	sample	B2
CUGRDS5	6/21/2002	Beryllium	0.00006	0.0005	mg/L	sample	J
CUGRDS5	6/21/2002	Cadmium	ND	0.0005	mg/L	sample	
CUGRDS5	6/21/2002	Chromium	0.00534	0.001	mg/L	sample	B2
CUGRDS5	6/21/2002	Copper	0.0018	0.001	mg/L	sample	B2
CUGRDS5	6/21/2002	Lead	0.000249	0.0005	mg/L	sample	J B1
CUGRDS5	6/21/2002	Manganese	0.103	0.0005	mg/L	sample	B2
CUGRDS5	6/21/2002	Nickel	0.00101	0.001	mg/L	sample	
CUGRDS5	6/21/2002	Selenium	ND	0.003	mg/L	sample	
CUGRDS5	6/21/2002	Silver	0.000488	0.0005	mg/L	sample	J
CUGRDS5	6/21/2002	Thallium	ND	0.0005	mg/L	sample	
CUGRDS5	6/21/2002	Zinc	0.00538	0.003	mg/L	sample	B1
CUGRHB3	6/21/2002	Arsenic	0.000309	0.001	mg/L	sample	J
CUGRHB3	6/21/2002	Antimony	0.000193	0.003	mg/L	sample	J B1
CUGRHB3	6/21/2002	Barium	0.00186	0.001	mg/L	sample	B2
CUGRHB3	6/21/2002	Beryllium	ND	0.0005	mg/L	sample	
CUGRHB3	6/21/2002	Cadmium	ND	0.0005	mg/L	sample	
CUGRHB3	6/21/2002	Chromium	0.00696	0.001	mg/L	sample	B2
CUGRHB3	6/21/2002	Copper	0.000547	0.001	mg/L	sample	J B2
CUGRHB3	6/21/2002	Lead	0.000042	0.0005	mg/L	sample	J B1
CUGRHB3	6/21/2002	Manganese	0.00824	0.0005	mg/L	sample	B2
CUGRHB3	6/21/2002	Nickel	0.000182	0.001	mg/L	sample	J
CUGRHB3	6/21/2002	Selenium	0.000585	0.003	mg/L	sample	J

CUGRHB3	6/21/2002	Silver	0.000489	0.0005	mg/L	sample	J
CUGRHB3	6/21/2002	Thallium	ND	0.0005	mg/L	sample	
CUGRHB3	6/21/2002	Zinc	0.00323	0.003	mg/L	sample	B1
CUGRDS5	6/21/2002	Arsenic	ND	0.001	mg/L	dup	
CUGRDS5	6/21/2002	Antimony	0.000103	0.003	mg/L	dup	J B1
CUGRDS5	6/21/2002	Barium	0.00688	0.001	mg/L	dup	B2
CUGRDS5	6/21/2002	Beryllium	0.000051	0.0005	mg/L	dup	J
CUGRDS5	6/21/2002	Cadmium	ND	0.0005	mg/L	dup	
CUGRDS5	6/21/2002	Chromium	0.00563	0.001	mg/L	dup	B2
CUGRDS5	6/21/2002	Copper	0.0018	0.001	mg/L	dup	B2
CUGRDS5	6/21/2002	Lead	0.000247	0.0005	mg/L	dup	J B1
CUGRDS5	6/21/2002	Manganese	0.0997	0.0005	mg/L	dup	B2
CUGRDS5	6/21/2002	Nickel	0.000963	0.001	mg/L	dup	J
CUGRDS5	6/21/2002	Selenium	ND	0.003	mg/L	dup	
CUGRDS5	6/21/2002	Silver	0.000474	0.0005	mg/L	dup	J
CUGRDS5	6/21/2002	Thallium	ND	0.0005	mg/L	dup	
CUGRDS5	6/21/2002	Zinc	0.00752	0.003	mg/L	dup	B1
CUGRDS5	6/21/2002	Arsenic	3.71	0.02	mg/L	ms	
CUGRDS5	6/21/2002	Antimony	2.71	0.06	mg/L	ms	B2
CUGRDS5	6/21/2002	Barium	3.42	0.02	mg/L	ms	B2
CUGRDS5	6/21/2002	Beryllium	0.106	0.01	mg/L	ms	
CUGRDS5	6/21/2002	Cadmium	0.0935	0.01	mg/L	ms	
CUGRDS5	6/21/2002	Chromium	0.418	0.02	mg/L	ms	B2
CUGRDS5	6/21/2002	Copper	0.501	0.02	mg/L	ms	B2
CUGRDS5	6/21/2002	Lead	1.02	0.01	mg/L	ms	B2
CUGRDS5	6/21/2002	Manganese	1.15	0.01	mg/L	ms	B2
CUGRDS5	6/21/2002	Nickel	0.981	0.02	mg/L	ms	
CUGRDS5	6/21/2002	Selenium	3.82	0.06	mg/L	ms	
CUGRDS5	6/21/2002	Silver	0.572	0.01	mg/L	ms	
CUGRDS5	6/21/2002	Thallium	3.83	0.01	mg/L	ms	
CUGRDS5	6/21/2002	Zinc	1.08	0.06	mg/L	ms	B2
CUGRDS5	6/21/2002	Arsenic	ND	0.002	mg/L	sample	
CUGRDS5	6/21/2002	Copper	0.0018	0.001	mg/L	sample	
CUGRDS5	6/21/2002	Lead	ND	0.0005	mg/L	sample	
CUGRDS5	6/21/2002	Selenium	ND	0.002	mg/L	sample	
CUGRDS5	6/21/2002	Arsenic	ND	0.002	mg/L	dup	
CUGRDS5	6/21/2002	Copper	0.0018	0.001	mg/L	dup	
CUGRDS5	6/21/2002	Lead	ND	0.0005	mg/L	dup	
CUGRDS5	6/21/2002	Selenium	ND	0.002	mg/L	dup	
CUGRDS5	6/21/2002	Arsenic	3.71	0.04	mg/L	ms	
CUGRDS5	6/21/2002	Copper	0.501	0.02	mg/L	ms	
CUGRDS5	6/21/2002	Lead	1.02	0.01	mg/L	ms	
CUGRDS5	6/21/2002	Selenium	3.84	0.04	mg/L	ms	
CUGRDS5	6/21/2002	Mercury	ND	0.0002	mg/L	sample	
CUGRHB3	6/21/2002	Mercury	ND	0.0002	mg/L	sample	
CUGRDS5	6/21/2002	Mercury	ND	0.0002	mg/L	dup	
CUGRDS5	6/21/2002	Mercury	0.00168	0.0002	mg/L	ms	
CUGRDS5	6/19/2002	Tributyl Phosphate	88.8		%	sample	

CUGRDS5	6/19/2002	Triphenyl Phosphate	74.8		%	sample
CUGRDS5	6/19/2002	Dichlorvos	ND	0.0197	ug/L	sample
CUGRDS5	6/19/2002	Mevinphos	ND	0.0197	ug/L	sample
CUGRDS5	6/19/2002	Ethoprop	ND	0.0296	ug/L	sample
CUGRDS5	6/19/2002	Naled	ND	0.0197	ug/L	sample
CUGRDS5	6/19/2002	Sulfotepp	ND	0.00987	ug/L	sample
CUGRDS5	6/19/2002	Monocrotophos	ND	0.00987	ug/L	sample
CUGRDS5	6/19/2002	Phorate	ND	0.0148	ug/L	sample
CUGRDS5	6/19/2002	Dimethoate	ND	0.0494	ug/L	sample
CUGRDS5	6/19/2002	Demeton,o-s	ND	0.0197	ug/L	sample
CUGRDS5	6/19/2002	Diazinon	ND	0.0197	ug/L	sample
CUGRDS5	6/19/2002	Disulfoton	ND	0.0148	ug/L	sample
CUGRDS5	6/19/2002	Parathion,methyl	ND	0.0296	ug/L	sample
CUGRDS5	6/19/2002	Ronnel	ND	0.0197	ug/L	sample
CUGRDS5	6/19/2002	Chlorpyrifos	ND	0.0148	ug/L	sample
CUGRDS5	6/19/2002	Malathion	ND	0.0197	ug/L	sample
CUGRDS5	6/19/2002	Fenthion	ND	0.00987	ug/L	sample
CUGRDS5	6/19/2002	Parathion	ND	0.0148	ug/L	sample
CUGRDS5	6/19/2002	Trichloronate	ND	0.00987	ug/L	sample
CUGRDS5	6/19/2002	Tetrachlorvinphos	ND	0.00987	ug/L	sample
CUGRDS5	6/19/2002	Merphos	ND	0.0148	ug/L	sample
CUGRDS5	6/19/2002	Tokuthion	ND	0.0148	ug/L	sample
CUGRDS5	6/19/2002	Fensulfothion	ND	0.0148	ug/L	sample
CUGRDS5	6/19/2002	Bolstar	ND	0.00987	ug/L	sample
CUGRDS5	6/19/2002	EPN	ND	0.00987	ug/L	sample
CUGRDS5	6/19/2002	Azinphos,methyl	ND	0.0148	ug/L	sample
CUGRDS5	6/19/2002	Coumaphos	ND	0.0148	ug/L	sample
CUGRHB3	6/19/2002	Tributyl Phosphate	95.1		%	sample
CUGRHB3	6/19/2002	Triphenyl Phosphate	87		%	sample
CUGRHB3	6/19/2002	Dichlorvos	ND	0.0191	ug/L	sample
CUGRHB3	6/19/2002	Mevinphos	ND	0.0191	ug/L	sample
CUGRHB3	6/19/2002	Ethoprop	ND	0.0286	ug/L	sample
CUGRHB3	6/19/2002	Naled	ND	0.0191	ug/L	sample
CUGRHB3	6/19/2002	Sulfotepp	ND	0.00954	ug/L	sample
CUGRHB3	6/19/2002	Monocrotophos	ND	0.00954	ug/L	sample
CUGRHB3	6/19/2002	Phorate	ND	0.0143	ug/L	sample
CUGRHB3	6/19/2002	Dimethoate	ND	0.0477	ug/L	sample
CUGRHB3	6/19/2002	Demeton,o-s	ND	0.0191	ug/L	sample
CUGRHB3	6/19/2002	Diazinon	ND	0.0191	ug/L	sample
CUGRHB3	6/19/2002	Disulfoton	ND	0.0143	ug/L	sample
CUGRHB3	6/19/2002	Parathion,methyl	ND	0.0286	ug/L	sample
CUGRHB3	6/19/2002	Ronnel	ND	0.0191	ug/L	sample
CUGRHB3	6/19/2002	Chlorpyrifos	ND	0.0143	ug/L	sample
CUGRHB3	6/19/2002	Malathion	ND	0.0191	ug/L	sample
CUGRHB3	6/19/2002	Fenthion	ND	0.00954	ug/L	sample
CUGRHB3	6/19/2002	Parathion	ND	0.0143	ug/L	sample
CUGRHB3	6/19/2002	Trichloronate	ND	0.00954	ug/L	sample
CUGRHB3	6/19/2002	Tetrachlorvinphos	ND	0.00954	ug/L	sample
CUGRHB3	6/19/2002	Merphos	ND	0.0143	ug/L	sample

CUGRHB3	6/19/2002	Tokuthion	ND	0.0143	ug/L	sample
CUGRHB3	6/19/2002	Fensulfothion	ND	0.0143	ug/L	sample
CUGRHB3	6/19/2002	Bolstar	ND	0.00954	ug/L	sample
CUGRHB3	6/19/2002	EPN	ND	0.00954	ug/L	sample
CUGRHB3	6/19/2002	Azinphos,methyl	ND	0.0143	ug/L	sample
CUGRHB3	6/19/2002	Coumaphos	ND	0.0143	ug/L	sample
CUGRDS5	6/21/2002	2,4-Dichlorophenylacetic acid	101		%	sample
CUGRDS5	6/21/2002	Dalapon	ND	0.0494	ug/L	sample
CUGRDS5	6/21/2002	4-Nitrophenol	ND	0.0494	ug/L	sample
CUGRDS5	6/21/2002	Dicamba	ND	0.0494	ug/L	sample
CUGRDS5	6/21/2002	Dichloroprop	ND	0.0494	ug/L	sample
CUGRDS5	6/21/2002	2,4-D	ND	0.0494	ug/L	sample
CUGRDS5	6/21/2002	Pentachlorophenol	ND	0.0494	ug/L	sample
CUGRDS5	6/21/2002	Silvex (2,4,5-TP)	ND	0.0494	ug/L	sample
CUGRDS5	6/21/2002	2,4,5-T	ND	0.0988	ug/L	sample
CUGRDS5	6/21/2002	Dinoseb	ND	0.0494	ug/L	sample
CUGRDS5	6/21/2002	2,4-DB	ND	0.0988	ug/L	sample
CUGRDS5	6/21/2002	MCPP	ND	0.0494	ug/L	sample
CUGRDS5	6/21/2002	MCPA	ND	0.0494	ug/L	sample
CUGRHB3	6/21/2002	2,4-Dichlorophenylacetic acid	85.2		%	sample
CUGRHB3	6/21/2002	Dalapon	ND	0.0477	ug/L	sample
CUGRHB3	6/21/2002	4-Nitrophenol	ND	0.0477	ug/L	sample
CUGRHB3	6/21/2002	Dicamba	ND	0.0477	ug/L	sample
CUGRHB3	6/21/2002	Dichloroprop	ND	0.0477	ug/L	sample
CUGRHB3	6/21/2002	2,4-D	ND	0.0477	ug/L	sample
CUGRHB3	6/21/2002	Pentachlorophenol	ND	0.0477	ug/L	sample
CUGRHB3	6/21/2002	Silvex (2,4,5-TP)	ND	0.0477	ug/L	sample
CUGRHB3	6/21/2002	2,4,5-T	ND	0.0954	ug/L	sample
CUGRHB3	6/21/2002	Dinoseb	ND	0.0477	ug/L	sample
CUGRHB3	6/21/2002	2,4-DB	ND	0.0954	ug/L	sample
CUGRHB3	6/21/2002	MCPP	ND	0.0477	ug/L	sample
CUGRHB3	6/21/2002	MCPA	ND	0.0477	ug/L	sample
CUGRDS5	6/23/2002	2 - Fluorophenol	71		%	sample
CUGRDS5	6/23/2002	Phenol - d5	39.1		%	sample
CUGRDS5	6/23/2002	Nitrobenzene - d5	121		%	sample
CUGRDS5	6/23/2002	2 - Fluorobiphenyl	117		%	sample
CUGRDS5	6/23/2002	2,4,6 - Tribromophenol	120		%	sample
CUGRDS5	6/23/2002	p - Terphenyl - d14	128		%	sample
CUGRDS5	6/23/2002	Naphthalene	ND	0.0509	ug/L	sample
CUGRDS5	6/23/2002	2-Methylnaphthalene	ND	0.0509	ug/L	sample
CUGRDS5	6/23/2002	2-Chloronaphthalene	ND	0.0509	ug/L	sample
CUGRDS5	6/23/2002	Acenaphthylene	ND	0.0509	ug/L	sample
CUGRDS5	6/23/2002	Acenaphthene	ND	0.0509	ug/L	sample
CUGRDS5	6/23/2002	Fluorene	ND	0.0509	ug/L	sample
CUGRDS5	6/23/2002	Phenanthrene	ND	0.0509	ug/L	sample
CUGRDS5	6/23/2002	Anthracene	ND	0.0509	ug/L	sample
CUGRDS5	6/23/2002	Fluoranthene	ND	0.0509	ug/L	sample
CUGRDS5	6/23/2002	Pyrene	ND	0.0509	ug/L	sample
CUGRDS5	6/23/2002	Benzo(a)anthracene	ND	0.0102	ug/L	sample

CUGRDS5	6/23/2002	Chrysene	ND	0.0102	ug/L	sample	
CUGRDS5	6/23/2002	Benzofluoranthenes	ND	0.0203	ug/L	sample	
CUGRDS5	6/23/2002	Benzo(a)pyrene	ND	0.0102	ug/L	sample	
CUGRDS5	6/23/2002	Indeno(1,2,3-cd)pyrene	ND	0.0102	ug/L	sample	
CUGRDS5	6/23/2002	Dibenz(a,h)anthracene	ND	0.0102	ug/L	sample	
CUGRDS5	6/23/2002	Benzo(g,h,i)perylene	ND	0.0102	ug/L	sample	
CUGRDS5	6/23/2002	Atrazine	ND	0.102	ug/L	sample	
CUGRHB3	6/27/2002	Nitrobenzene - d5	77		%	sample	
CUGRHB3	6/27/2002	2 - Fluorobiphenyl	132		%	sample	X9
CUGRHB3	6/27/2002	p - Terphenyl - d14	159		%	sample	X9
CUGRHB3	6/27/2002	Naphthalene	ND	0.478	ug/L	sample	
CUGRHB3	6/27/2002	2-Methylnaphthalene	ND	0.478	ug/L	sample	
CUGRHB3	6/27/2002	2-Chloronaphthalene	ND	0.478	ug/L	sample	
CUGRHB3	6/27/2002	Acenaphthylene	ND	0.478	ug/L	sample	
CUGRHB3	6/27/2002	Acenaphthene	ND	0.478	ug/L	sample	
CUGRHB3	6/27/2002	Fluorene	ND	0.478	ug/L	sample	
CUGRHB3	6/27/2002	Phenanthrene	ND	0.478	ug/L	sample	
CUGRHB3	6/27/2002	Anthracene	ND	0.478	ug/L	sample	
CUGRHB3	6/27/2002	Fluoranthene	ND	0.478	ug/L	sample	
CUGRHB3	6/27/2002	Pyrene	ND	0.478	ug/L	sample	
CUGRHB3	6/27/2002	Benzo(a)anthracene	ND	0.0956	ug/L	sample	
CUGRHB3	6/27/2002	Chrysene	ND	0.0956	ug/L	sample	
CUGRHB3	6/27/2002	Benzofluoranthenes	ND	0.191	ug/L	sample	
CUGRHB3	6/27/2002	Benzo(a)pyrene	ND	0.0956	ug/L	sample	
CUGRHB3	6/27/2002	Indeno(1,2,3-cd)pyrene	ND	0.0956	ug/L	sample	
CUGRHB3	6/27/2002	Dibenz(a,h)anthracene	ND	0.0956	ug/L	sample	
CUGRHB3	6/27/2002	Benzo(g,h,i)perylene	ND	0.0956	ug/L	sample	
CUGRHB3	6/27/2002	Atrazine	ND	0.956	ug/L	sample	
CUGRDS5	6/18/2002	Fluoride	ND	0.06	mg/L	sample	
CUGRDS5	6/18/2002	Chloride	0.452	0.3	mg/L	sample	
CUGRDS5	6/18/2002	Nitrite as N	ND	0.031	mg/L	sample	
CUGRDS5	6/18/2002	Nitrate as N	ND	0.03	mg/L	sample	
CUGRDS5	6/18/2002	Sulfate	0.223	0.3	mg/L	sample	J
CUGRHB3	6/18/2002	Fluoride	ND	0.06	mg/L	sample	
CUGRHB3	6/18/2002	Chloride	0.829	0.3	mg/L	sample	
CUGRHB3	6/18/2002	Nitrite as N	ND	0.031	mg/L	sample	
CUGRHB3	6/18/2002	Nitrate as N	ND	0.03	mg/L	sample	
CUGRHB3	6/18/2002	Sulfate	0.562	0.3	mg/L	sample	
CUGRDS5	6/18/2002	Fluoride	ND	0.06	mg/L	dup	
CUGRDS5	6/18/2002	Chloride	0.463	0.3	mg/L	dup	
CUGRDS5	6/18/2002	Nitrite as N	ND	0.031	mg/L	dup	
CUGRDS5	6/18/2002	Nitrate as N	ND	0.03	mg/L	dup	
CUGRDS5	6/18/2002	Sulfate	0.276	0.3	mg/L	dup	J
CUGRDS5	6/18/2002	Fluoride	7.58	0.0606	mg/L	ms	
CUGRDS5	6/18/2002	Chloride	39.4	0.303	mg/L	ms	
CUGRDS5	6/18/2002	Nitrite as N	2.14	0.0313	mg/L	ms	
CUGRDS5	6/18/2002	Nitrate as N	3.9	0.0303	mg/L	ms	
CUGRDS5	6/18/2002	Sulfate	40.3	0.303	mg/L	ms	
	6/21/2002	Iron	ND	0.1	mg/L	blank	

6/21/2002	Sodium	ND	1	mg/L	blank	
6/21/2002	Cadmium	ND	0.005	mg/L	blank	
6/21/2002	Chromium	ND	0.01	mg/L	blank	
6/21/2002	Copper	ND	0.01	mg/L	blank	
6/21/2002	Lead	ND	0.01	mg/L	blank	
6/21/2002	Nickel	ND	0.01	mg/L	blank	
6/21/2002	Silver	ND	0.01	mg/L	blank	
6/21/2002	Zinc	ND	0.01	mg/L	blank	
6/21/2002	Arsenic	ND	0.001	mg/L	blank	
6/21/2002	Antimony	0.000048	0.003	mg/L	blank	J
6/21/2002	Barium	0.00002	0.001	mg/L	blank	J
6/21/2002	Beryllium	ND	0.0005	mg/L	blank	
6/21/2002	Cadmium	ND	0.0005	mg/L	blank	
6/21/2002	Chromium	0.000078	0.001	mg/L	blank	J
6/21/2002	Copper	0.000036	0.001	mg/L	blank	J
6/21/2002	Lead	0.000028	0.0005	mg/L	blank	J
6/21/2002	Manganese	0.000157	0.0005	mg/L	blank	J
6/21/2002	Nickel	ND	0.001	mg/L	blank	
6/21/2002	Selenium	ND	0.003	mg/L	blank	
6/21/2002	Silver	ND	0.0005	mg/L	blank	
6/21/2002	Thallium	ND	0.0005	mg/L	blank	
6/21/2002	Zinc	0.00184	0.003	mg/L	blank	J
6/21/2002	Arsenic	ND	0.002	mg/L	blank	
6/21/2002	Copper	ND	0.001	mg/L	blank	
6/21/2002	Lead	ND	0.0005	mg/L	blank	
6/21/2002	Selenium	ND	0.002	mg/L	blank	
6/21/2002	Mercury	ND	0.0002	mg/L	blank	
6/19/2002	Tributyl Phosphate	81.5		%	blank	
6/19/2002	Triphenyl Phosphate	77.3		%	blank	
6/19/2002	Dichlorvos	ND	0.02	ug/L	blank	
6/19/2002	Mevinphos	ND	0.02	ug/L	blank	
6/19/2002	Ethoprop	ND	0.03	ug/L	blank	
6/19/2002	Naled	ND	0.02	ug/L	blank	
6/19/2002	Sulfotepp	ND	0.01	ug/L	blank	
6/19/2002	Monocrotophos	ND	0.01	ug/L	blank	
6/19/2002	Phorate	ND	0.015	ug/L	blank	
6/19/2002	Dimethoate	ND	0.05	ug/L	blank	
6/19/2002	Demeton,o-s	ND	0.02	ug/L	blank	
6/19/2002	Diazinon	ND	0.02	ug/L	blank	
6/19/2002	Disulfoton	ND	0.015	ug/L	blank	
6/19/2002	Parathion,methyl	ND	0.03	ug/L	blank	
6/19/2002	Ronnel	ND	0.02	ug/L	blank	
6/19/2002	Chlorpyrifos	ND	0.015	ug/L	blank	
6/19/2002	Malathion	ND	0.02	ug/L	blank	
6/19/2002	Fenthion	ND	0.01	ug/L	blank	
6/19/2002	Parathion	ND	0.015	ug/L	blank	
6/19/2002	Trichloronate	ND	0.01	ug/L	blank	
6/19/2002	Tetrachlorvinphos	ND	0.01	ug/L	blank	
6/19/2002	Merphos	ND	0.015	ug/L	blank	

6/19/2002	Tokuthion	ND	0.015	ug/L	blank
6/19/2002	Fensulfothion	ND	0.015	ug/L	blank
6/19/2002	Bolstar	ND	0.01	ug/L	blank
6/19/2002	EPN	ND	0.01	ug/L	blank
6/19/2002	Azinphos,methyl	ND	0.015	ug/L	blank
6/19/2002	Coumaphos	ND	0.015	ug/L	blank
6/19/2002	Tributyl Phosphate	96.2		%	bs
6/19/2002	Triphenyl Phosphate	91		%	bs
6/19/2002	Diazinon	1.17	0.02	ug/L	bs
6/19/2002	Chlorpyrifos	1.08	0.015	ug/L	bs
6/19/2002	Malathion	1.2	0.02	ug/L	bs
6/19/2002	Azinphos,methyl	1.04	0.015	ug/L	bs
6/19/2002	Tributyl Phosphate	87		%	bsd
6/19/2002	Triphenyl Phosphate	77.7		%	bsd
6/19/2002	Diazinon	0.923	0.02	ug/L	bsd
6/19/2002	Chlorpyrifos	0.859	0.015	ug/L	bsd
6/19/2002	Malathion	0.896	0.02	ug/L	bsd
6/19/2002	Azinphos,methyl	0.855	0.015	ug/L	bsd
6/21/2002	2,4-Dichlorophenylacetic acid	85.3		%	blank
6/21/2002	Dalapon	ND	0.05	ug/L	blank
6/21/2002	4-Nitrophenol	ND	0.05	ug/L	blank
6/21/2002	Dicamba	ND	0.05	ug/L	blank
6/21/2002	Dichloroprop	ND	0.05	ug/L	blank
6/21/2002	2,4-D	ND	0.05	ug/L	blank
6/21/2002	Pentachlorophenol	ND	0.05	ug/L	blank
6/21/2002	Silvex (2,4,5-TP)	ND	0.05	ug/L	blank
6/21/2002	2,4,5-T	ND	0.1	ug/L	blank
6/21/2002	Dinoseb	ND	0.05	ug/L	blank
6/21/2002	2,4-DB	ND	0.1	ug/L	blank
6/21/2002	MCPP	ND	0.05	ug/L	blank
6/21/2002	MCPA	ND	0.05	ug/L	blank
6/21/2002	2,4-Dichlorophenylacetic acid	96		%	bs
6/21/2002	Dalapon	2.4	0.05	ug/L	bs
6/21/2002	Dicamba	4.8	0.05	ug/L	bs
6/21/2002	2,4-D	5.84	0.05	ug/L	bs
6/21/2002	Pentachlorophenol	5.33	0.05	ug/L	bs
6/21/2002	Silvex (2,4,5-TP)	5.55	0.05	ug/L	bs
6/21/2002	Dinoseb	5.3	0.05	ug/L	bs
6/21/2002	MCPP	5.64	0.05	ug/L	bs
6/21/2002	2,4-Dichlorophenylacetic acid	90.2		%	bsd
6/21/2002	Dalapon	2.35	0.05	ug/L	bsd
6/21/2002	Dicamba	4.46	0.05	ug/L	bsd
6/21/2002	2,4-D	5.25	0.05	ug/L	bsd
6/21/2002	Pentachlorophenol	4.97	0.05	ug/L	bsd
6/21/2002	Silvex (2,4,5-TP)	5.34	0.05	ug/L	bsd
6/21/2002	Dinoseb	5.01	0.05	ug/L	bsd
6/21/2002	MCPP	5.28	0.05	ug/L	bsd
6/21/2002	2 - Fluorophenol	77.2		%	blank
6/21/2002	Phenol - d5	44		%	blank

6/21/2002	Nitrobenzene - d5	92		%	blank
6/21/2002	2 - Fluorobiphenyl	96		%	blank
6/21/2002	2,4,6 - Tribromophenol	99.3		%	blank
6/21/2002	p - Terphenyl - d14	119		%	blank
6/21/2002	Naphthalene	ND	0.05	ug/L	blank
6/21/2002	2-Methylnaphthalene	ND	0.05	ug/L	blank
6/21/2002	2-Chloronaphthalene	ND	0.05	ug/L	blank
6/21/2002	Acenaphthylene	ND	0.05	ug/L	blank
6/21/2002	Acenaphthene	ND	0.05	ug/L	blank
6/21/2002	Fluorene	ND	0.05	ug/L	blank
6/21/2002	Phenanthrene	ND	0.05	ug/L	blank
6/21/2002	Anthracene	ND	0.05	ug/L	blank
6/21/2002	Fluoranthene	ND	0.05	ug/L	blank
6/21/2002	Pyrene	ND	0.05	ug/L	blank
6/21/2002	Benzo(a)anthracene	ND	0.01	ug/L	blank
6/21/2002	Chrysene	ND	0.01	ug/L	blank
6/21/2002	Benzofluoranthenes	ND	0.02	ug/L	blank
6/21/2002	Benzo(a)pyrene	ND	0.01	ug/L	blank
6/21/2002	Indeno(1,2,3-cd)pyrene	ND	0.01	ug/L	blank
6/21/2002	Dibenz(a,h)anthracene	ND	0.01	ug/L	blank
6/21/2002	Benzo(g,h,i)perylene	ND	0.01	ug/L	blank
6/21/2002	Atrazine	ND	0.1	ug/L	blank
6/21/2002	2 - Fluorophenol	96.9		%	bs
6/21/2002	Phenol - d5	54.5		%	bs
6/21/2002	Nitrobenzene - d5	97.7		%	bs
6/21/2002	2 - Fluorobiphenyl	125		%	bs
6/21/2002	2,4,6 - Tribromophenol	138		%	bs
6/21/2002	p - Terphenyl - d14	135		%	bs
6/21/2002	Naphthalene	0.721	0.05	ug/L	bs
6/21/2002	2-Methylnaphthalene	0.762	0.05	ug/L	bs
6/21/2002	2-Chloronaphthalene	0.954	0.05	ug/L	bs
6/21/2002	Acenaphthylene	0.771	0.05	ug/L	bs
6/21/2002	Acenaphthene	0.956	0.05	ug/L	bs
6/21/2002	Fluorene	0.979	0.05	ug/L	bs
6/21/2002	Phenanthrene	0.937	0.05	ug/L	bs
6/21/2002	Anthracene	0.971	0.05	ug/L	bs
6/21/2002	Fluoranthene	0.94	0.05	ug/L	bs
6/21/2002	Pyrene	1.01	0.05	ug/L	bs
6/21/2002	Benzo(a)anthracene	0.762	0.01	ug/L	bs
6/21/2002	Chrysene	1.02	0.01	ug/L	bs
6/21/2002	Benzofluoranthenes	1.96	0.02	ug/L	bs
6/21/2002	Benzo(a)pyrene	0.9	0.01	ug/L	bs
6/21/2002	Indeno(1,2,3-cd)pyrene	1.05	0.01	ug/L	bs
6/21/2002	Dibenz(a,h)anthracene	1.04	0.01	ug/L	bs
6/21/2002	Benzo(g,h,i)perylene	0.983	0.01	ug/L	bs
6/21/2002	Atrazine	1.02	0.1	ug/L	bs
6/27/2002	Nitrobenzene - d5	88.3		%	bsd
6/27/2002	2 - Fluorobiphenyl	124		%	bsd
6/27/2002	p - Terphenyl - d14	122		%	bsd

6/27/2002	Naphthalene	0.847	0.05	ug/L	bsd
6/27/2002	2-Methylnaphthalene	0.92	0.05	ug/L	bsd
6/27/2002	2-Chloronaphthalene	1.03	0.05	ug/L	bsd
6/27/2002	Acenaphthylene	0.884	0.05	ug/L	bsd
6/27/2002	Acenaphthene	1.19	0.05	ug/L	bsd
6/27/2002	Fluorene	1.01	0.05	ug/L	bsd
6/27/2002	Phenanthrene	1.09	0.05	ug/L	bsd
6/27/2002	Anthracene	0.918	0.05	ug/L	bsd
6/27/2002	Fluoranthene	1.04	0.05	ug/L	bsd
6/27/2002	Pyrene	1.02	0.05	ug/L	bsd
6/27/2002	Benzo(a)anthracene	0.915	0.01	ug/L	bsd
6/27/2002	Chrysene	1.1	0.01	ug/L	bsd
6/27/2002	Benzofluoranthenes	3.18	0.02	ug/L	bsd
6/27/2002	Benzo(a)pyrene	1.1	0.01	ug/L	bsd
6/27/2002	Indeno(1,2,3-cd)pyrene	0.951	0.01	ug/L	bsd
6/27/2002	Dibenz(a,h)anthracene	0.733	0.01	ug/L	bsd
6/27/2002	Benzo(g,h,i)perylene	1.05	0.01	ug/L	bsd
6/27/2002	Atrazine	0.562	0.1	ug/L	bsd
6/18/2002	Fluoride	ND	0.06	mg/L	blank
6/18/2002	Chloride	ND	0.3	mg/L	blank
6/18/2002	Nitrite as N	ND	0.031	mg/L	blank
6/18/2002	Nitrate as N	ND	0.03	mg/L	blank
6/18/2002	Sulfate	ND	0.3	mg/L	blank
6/18/2002	Fluoride	7.78	0.06	mg/L	bs
6/18/2002	Chloride	38.1	0.3	mg/L	bs
6/18/2002	Nitrite as N	2.02	0.031	mg/L	bs
6/18/2002	Nitrate as N	3.83	0.03	mg/L	bs
6/18/2002	Sulfate	39.5	0.3	mg/L	bs

TABLE C

Phytoplankton Sample Analysis

Sample: Cougar Lake
Sample Station:
Sample Depth:
Sample Date: 29-Aug-02

Total Density (#/mL):	3,221
Total Biovolume (um^3/mL):	6,008,367
Trophic State Index:	62.8

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent
1	Anabaena flos-aquae	2,550	79.2	4,955,228	82.5
2	Anabaena circinalis	349	10.8	963,207	16.0
3	Ankistrodesmus falcatus	161	5.0	4,027	0.1
4	Cryptomonas erosa	54	1.7	27,919	0.5
5	Cymbella sinuata	27	0.8	3,758	0.1
6	Melosira varians	27	0.8	34,899	0.6
7	Glenodinium sp.	27	0.8	18,792	0.3
8	Rhodomonas minuta	27	0.8	537	0.0

Anabaena flos-aquae cells/mL =	73,959
Anabaena flos-aquae heterocysts/mL =	2,174
Anabaena flos-aquae akinetes/mL =	537

Appendix B

Cougar Reservoir Temperature Control Project
Sediment Quality Evaluation

June 4-5 & August 6-7, 2002
Sampling Events

Prepared by Portland
District Corps of Engineers

Appendix B
Cougar Reservoir Temperature Control Project
Sediment Quality Evaluation

ABSTRACT

In 1996, during the design phase of the project, Geotechnical Resources Inc. submitted twelve (12) surface grab sediment samples for physical and chemical analyses. These samples were collected at the 1400' contour near the intake structure and diversion tunnel and upstream locations, with results published in the Design Memorandum No. 21. No organic contaminates were detected above method detection levels (MDL) and metals were detected only at low levels and were considered at background levels. However, with the greater than anticipated amount of erosion and resulting turbidity during the drawdown process, questions from the public were raised about potential contaminate levels in the turbidity and possible sediment releases. As a result, twelve (12) surface sediment samples, targeting fine-grained sediment and organic material, were collected in June 2002. These samples were collected to target fine-grain and organic material that had been eroded during the drawdown, with one (1) sample to represent lakebed sediments, which were exposed after the drawdown event. All samples were submitted for physical parameters including total volatile solids and five (5) samples were chemically analyzed for heavy metals (9 inorganic), total organic carbon, pesticides and polychlorinated biphenyls (PCBs), phenols, phthalates, miscellaneous extractables and polynuclear aromatic hydrocarbons.

Dichlorodiphenyltrichloroethane (DDT) was detected above levels of concern[1,2] in four (4) of the five (5) samples collected during the June sampling event. As a result of these findings, a follow-up sampling event was conducted on August 6-7, 2002, which analyzed fifteen (15) samples for physical parameters, total organic carbon (TOC) and total DDT (DDT+DDE+DDD or Σ DDT). This event detected no Σ DDT, at MDLs (Method Detection Limits), present in surface sediments taken at two (2) locations in the McKenzie River, downstream of the dam and upstream of the reservoir. Only low levels of Σ DDT (~15% of S.L.) were detected near the inlet to the diversion tunnel, with one (1) of five (5) samples collected from within the current reservoir exceeding screening levels for Σ DDT [1,2] (see Table 9, pages 14-16 for complete results). Samples collected from potential future erosive sites, within the reservoir, contained Σ DDT at levels above the S.L [1,2]. Future sediment monitoring is recommended during winter storm events, to document turbidity and potential sediment migration to evaluate potential transport of Σ DDT.

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[1] Dredge Material Evaluation Framework – Screening level for open water disposal 6.9 ug/kg total DDT.
[2] Oregon Department of Environmental Quality – Level II screening level 7.0 ug/kg total DDT.
[3] See Attachment A & B for complete Sampling and Analysis Plans

INTRODUCTION

This report will evaluate analytical data from both the June and August 2002 sampling events. The goal of the June 2002 sampling event[3] was to target fine-grained sediment and organic material, because most contaminates of concern bind to these substrates. The samples taken in the June event, from cutbanks adjacent to areas of erosion, collected to represent the eroded material, targeted only the fine-grained and organic lens within the vertical profile and did not represent the entire volume of material that has been eroded. Due to the detection of Σ DDT in these samples, the August 2002 sampling event[3] attempted to satisfy the following questions, with the corresponding action:

1. What levels of Σ DDT are in the background?

Collect background sediment from above the reservoir on the South Fork of the McKenzie (both in-water and upland).

2. What levels of Σ DDT are represented in the total volume of sediment eroded and those that have a potential for future erosion?

   Collect vertical profile samples from the cut-bank areas where only the fine-grained sediment was targeted in the first sampling event in June were collected.

3. What levels of Σ DDT are exposed in the current reservoir?

   Collect surface sediment, which has recently been eroded and homogenized during the drawdown even, from all the newly formed delta areas in the current reservoir (1400 foot level).

4. What levels of Σ DDT might have migrated beyond the confines of the reservoir?

   Collect recently deposited sediment from just below the dam that would represent sediment that was released during the drawdown.

PREVIOUS STUDIES

In February of 1996 twelve (12) surface grab sediment samples were submitted, by Geotechnical Resources Inc., to the Corp's materials lab (Troutdale, OR) for physical analysis and Sound Analytical Services laboratory for chemical analyses. These samples were collected, from within the reservoir, at the 1400' contour near the intake structure and diversion tunnel and several upstream locations. Physical parameters included soil classification, particle size and dredge test analysis, with analysis varying from 80% gravel to 90% silt. Chemical methods TPH-HCID (petroleum hydrocarbon identification) with quantification for gasoline, TPH-418.1 (Total Recoverable Petroleum Hydrocarbons), 8 RCRA metals, 1311 TCLP (leachability of metals), EPA 200.8 (Trace metals), 7471 (lead), 8080 (chlorinated pesticides and PCBs) and TOC (total organic carbon) were performed on select samples. No organic contaminates were detected above method detection levels (MDL) and metals were detected only at low levels and are considered at background. The laboratory encountered some minor problems with matrix interferences causing recovery levels for several surrogate analyses to be outside the recommended range. These problems are considered minor and do not affect the confidence on the overall data objectives.

CURRENT STUDIES

JUNE 4-5, 2002 SAMPLING EVENT

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During the drawdown process, erosion of the fine-grained sediment delta areas, formed where tributaries enter the reservoir, had occurred. The eroded sediments caused turbidity and sedimentation concerns within and downstream of the reservoir. In addition to the concern of turbidity levels, the question of possible distribution of contamination, contained within the sediments, had arisen. Members of the public expressed concern for the presence of some heavy metals and the use of herbicides and pesticides in areas upstream of the reservoir. Due to the large amounts of sediment being eroded and the concerns expressed, sampling was scheduled.

Twelve (12) physical and five (5) chemical analyses were collected from delta areas. Physical parameters included soil classification, particle size and dredge test analysis, with chemical analyses including: metals (6020/7471), total organic carbon (TOC) method 9060, polynuclear aromatic hydrocarbons (PAHs), phenols, phthalates, chlorinated organic compounds, misc. extractables by 8270 SIM method (low level detection method), pesticides/PCBs by 8081/8082 and chlorinated herbicides by method 8151, conducted by Severn Trent Laboratory in Tacoma. DDT and its breakdown products were the only chemicals detected at levels of concern. [1,2]

The following areas were selected for chemical analyses (with corresponding Σ DDT levels as indicated), two (2) samples were collected from East Fork cut banks (Σ DDT @ 8.5 & 32.6 ppb), one (1) sample below from below the Slide Creek boat ramp, from a delta cut bank (Σ DDT @ 23.9 ppb), one (1) sample from the Annie Creek delta (Σ DDT @ 18.6 ppb), and one (1) sample was collected from lake deposits near the face of the dam on the Rush Creek side (Σ DDT @ 5.3 ppb).

Table 1. June 4 & 5, 2002 Sampling Event, Sampling Station Coordinates (NAD 83, Oregon State Plane South) (Coordinates for samples submitted for physical analysis only, not available).

COUG-G-05 44º 04.846’ 122º 13.670’ Slide Creek – main channel bank.	COUG-G-07 44º 07.145’ 122º 13.726’ North bank of East Fork.	COUG-G-09 44º 07.181’ 122º 13.561’ North bank of East Fork.
COUG-G-11 44º 07.616’ 122º 14.443’ Lake deposit – mid-dam	COUG-G-13 44º 05.949’ 122º 13.778’ Annie Creek – Near main channel.	

AUGUST 6-7, 2002 SAMPLING EVENT

During the August event fifteen (15) samples were collected and analyzed for Σ DDT, total organic carbon (TOC) and physical parameters; this was a follow-up to the Σ DDT detected, above SL, in the June event. Basic objectives are stated in the Introduction section above, as well as, in the SAP attached in Attachment B. The samples were collected as follows: two (2) background samples collected from the South Fork of the McKenzie above the reservoir; three (3) vertical profile samples from the cut-bank areas, where only the fine-grained sediment was targeted in June; five (5) surface composite sediment samples collected from the reservoir, to represent the recently eroded and re-homogenized sediment from the drawdown even. Each of these five (5) samples analyzed were a composite of 2-3 surface grabs from designated areas within the current reservoir. Two (2) additional surface samples were collected, downstream of the dam, on the McKenzie River, from slack water areas where Σ DDT might have been deposited, if it had migrated beyond the confines of the reservoir. One upland station was sampled and two samples submitted for analyses. These samples were collected from forest floor debris, about one-half mile northeast of the bridge crossing the South Fork, upstream of the reservoir. Samples represented the surface - 6”depth and 6”-12” depth of forest floor debris.

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Table 2. August 6 & 7, 2002 Sampling Event, Sampling Station Coordinates (NAD 83, Oregon State Plane South).

COUG-G-14 (No GPS Reading Available) Downstream of Powerhouse – east bank.	COUG-G-15 44º 08.568' 122º 14.323' USGS gauging station	COUG-G-16 44º 03.373' 122º 13.127' Upstream of reservoir.
COUG-G-17 44º 03.395' 122º 13.133' Upstream of reservoir.	COUG-G-18 44º 02.816' 122º 12.961' Upland – above reservoir.	COUG-G-19 44º 02.816' 122º 12.961' Upland – above reservoir (same location as COUG-G-18.
COUG-G-20 44º 04.732' 122º 13.671' (Same location as COUG-G-06) Slide Creek – main channel bank.	COUG-G-21 44º 04.843' 122º 13.664' (Same location as COUG-G-05) Slide Creek – main channel bank.	COUG-G-22 44º 07.138' 122º 13.720' (Same location as COUG-G-07) North bank of East Fork.
COUG-G-23 44º 07.178' 122º 13.568' (Same location as COUG-G-09) North bank of East Fork.	COUG-G-24 44º 07.035' 122º 14.026' 44º 07.035' 122º 14.036' 44º 07.034' 122º 14.036' Composite of 3 samples in delta of East fork – after drawdown.	COUG-G-25 44º 06.433' 122º 13.918' 44º 06.431' 122º 13.924' 44º 06.447' 122º 13.965' Composite of 3 samples in delta of South fork – after drawdown.
COUG-G-26 44º 06.724' 122º 13.935' 44º 06.734' 122º 13.932' Approximately halfway between East Fork & South fork. Composite of 2 samples from both sides of Reservoir – after drawdown.	COUG-G-27 44º 07.507' 122º 14.490' 44º 07.539' 122º 14.431' 44º 07.590' 122º 14.393' Composite of 3 samples near inlet to diversion tunnel – after drawdown.	COUG-G-28 44º 07.534' 122º 14.306' 44º 07.546' 122º 14.306' 44º 07.538' 122º 14.300' Composite of 3 samples in delta at Northeast end of reservoir – after drawdown.

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RESULTS – JUNE 4-5, 2002 & AUGUST 6-7, 2002

Physical and Total Volatile Solids (TVS) (ASTM methods).

June Event: Twelve (12) samples were submitted for physical and TVS analyses; data are presented in Table 3. Four (4) samples were classified as "silt with sand, five (5) samples were classified as "silt" and three (3) samples were classified as "sandy silt." Mean grain-size for all the samples is 0.04 mm, with 0.06% gravel, 22.0% sand and 78.0% fines. Volatile solids for all the samples ranged from 25600 mg/kg to 82200 mg/kg.

August Event: Fifteen (15) samples were submitted for physical and TVS analyses; data are presented in Table 8. Five (5) samples were classified as "silty sand". Two (2) samples each were classified as "silt with sand", and "sandy silt." One (1) sample each was classified as "poorly graded gravel", "poorly graded sand with gravel," "poorly graded sand," "well graded sand with, gravel," "poorly graded sand with silt and gravel" and "elastic silt." Mean grain-size for all the samples is 1.29 mm, with 14.8% gravel, 51.85% sand and 40.45% fines. Volatile solids for all the samples ranged from 1390 mg/kg to 53700 mg/kg.

Metals (EPA method 6020/7471), Total Organic Carbon (EPA method 9060).

June Event: Five (5) samples were submitted for testing and the data are presented in Table 4. The TOC ranged from 10,800 to 103,000 mg/kg in the samples.

Low levels of most metals were found, but did not approach the screening levels (SL) in the DMEF. Cu & Ni exceeded DEQ Level II screening levels; Cu & Ni levels are consistent in all the samples and consistent with other sample analyses from the Willamette Valley area and are considered background.

August Event: Fifteen (15) samples were submitted for TOC testing, data are presented in Table 9. The TOC ranged from 1180 to 240,000 mg/kg in the samples. No metals were run on these samples, because follow-up to the June sampling event, for metals, was determined not to be necessary.

Pesticides/PCBs (EPA method 8081A/8082), Phenols, Phthalates and Miscellaneous Extractables (EPA method 8270).

June Event: Five (5) samples were tested for pesticides/PCBs and the data are presented in Table 5. No PCBs were found at the MDL in any of the samples. No pesticides (except Σ DDT) were found at the MDL in any of the samples. Two phthalate compounds were detected in one sample each, and the values were well below their respective SLs. No phenols were detected in any samples above MDLs. One miscellaneous extractable (n-nitroso-di-n-propylamine)(DPN) was found in one (1) sample, COUG-G-07. This was not confirmed in the quality assurance (QA) split sample. This chemical is produced primarily as a research chemical and not for commercial purposes (Spectrum). DPN was not considered to be a chemical of further interest.

The following stations were tested for Σ DDT (with corresponding levels as indicated), two (2) samples were collected from East Fork cut banks (Σ DDT @ 8.5 & 32.6 ppb), one (1) sample below from the Slide Creek boat ramp, from a delta cut bank (Σ DDT @ 23.9 ppb), one (1) sample from the Annie Creek delta (Σ DDT @ 18.6 ppb), and one (1) sample was collected from lake deposits near the face of the dam on the Rush Creek side (Σ DDT @ 5.3 ppb).

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August Event: Fifteen (15) samples were submitted for Σ DDT (DDT, DDE & DDE) analyses.

Fifteen (15) samples were collected and analyzed for Σ DDT; two (2) background samples collected from the South Fork of the McKenzie above the reservoir (no Σ DDT detected, <2.6% fines); three (3) vertical profile samples from the cut-bank areas where only the fine-grained sediment was targeted in June (7.27, 7.11 & 17.65 ppb); five (5) surface composite sediment samples collected from the reservoir to represent the recently eroded and homogenized during the drawdown even (ND @ 0.7 ug/kg-ppb), 1.08, 4.77, 6.19 & 25.87 ppb). Each of these five (5) samples analyzed were a composite of 2-3 surface grabs from a designated area of the reservoir; two (2) surface samples from the McKenzie River, downstream of the dam (both ND @ <0.7 ppb) in slack water areas, where Σ DDT contaminated sediments might have been deposited, if it had migrated beyond the confines of the reservoir. One (1) upland station was sampled, upland on a logging road cut bank. Samples represented the surface to 6"depth and 6"-12" depth of forest floor debris (Σ DDT @ 374.6 ppb top 6") and (Σ DDT @ 36.9 ppb 6" – 12" depth).

Polynuclear Aromatic Hydrocarbons (EPA method 8270C).

June Event: Five (5) samples were submitted for testing, data are presented in Table 7 & 8. No "low or high molecular weight" PAHs were detected at the MDL in the samples.

August Event: No samples were submitted for method 8270C.

CONCLUSION

Dichlorodiphenyltrichloroethane (Σ DDT) was detected above levels of concern[1,2] in four (4) of the five (5) samples collected during the June sampling event. As a result of these findings, a follow-up sampling event was conducted on August 6-7, 2002, which analyzed fifteen (15) samples for physical parameters, total organic carbon (TOC) and Σ DDT. This event detected no Σ DDT present in surface sediments taken at two (2) locations in the McKenzie River, downstream of the dam or in two (2) samples from upstream of the reservoir (<2.6% fines). Only low levels of Σ DDT (<16% of S.L.) were detected near the inlet to the diversion tunnel, with one (1) of five (5) samples collected from within the current reservoir exceeding screening levels [1,2], for Σ DDT. Samples collected from potential future erosive sites, within the reservoir, also, contained Σ DDT at levels above the S.L [1,2].

The original source of the pesticide, dichlorodiphenyltrichloroethane, was likely from forest applications to public and private lands, in 1949, in this area to control budworm at a rate of approximately one (1) pound per acre. The one (1) upland station sampled, with two (2) analyses, was collected upland on a logging road cutbank and represented the surface to 6"depth and 6"-12" depth of forest floor debris (Σ DDT @ 374.6 ppb top 6") and (Σ DDT @ 36.9 ppb 6" – 12" depth). This level of Σ DDT is consistent with a one (1) pound per acre application, with a fifteen (15) year half-life of Σ DDT. The earlier material that eroded into the reservoir appears to have contained higher levels of Σ DDT than later sediments entering the reservoir; evidenced by surface sediments collected in the reservoir in the 1996 event and undisturbed surface lakebed sediments not containing detectable levels of Σ DDT, with sediments at lower levels containing higher levels of Σ DDT. The data would indicate that Σ DDT had collected behind the reservoir and then been covered with cleaner non-contaminated sediment, effectively isolating it from aquatic and benthic organisms. It is likely that this same "capping" effect will take place, covering any Σ DDT exposed during the drawdown events, following construction of the Temperature Control Structure when "normal" operation or the reservoir is resumed.

While Σ DDT was detected in sediments within the reservoir and in upland samples, it was not measurable in sediments below the reservoir and only at low levels in areas near the inlet to the diversion tunnel outlet from the reservoir. It is likely that some floating organic material (fir needles, twigs, etc.), binding DDT, was released during the initial drawdown, but this material was likely distributed over a very large area, and not measurable nor posing any significant risk to the environment, due to dilution by distribution. Because Σ DDT is hydrophobic (little affinity for water) it will tend to remain bound to the organic material and not dissolve into the water column.

The sediment represented by sample COUG-G-26 contained Σ DDT at 25.87 ppb. This sample was a composite of two (2) samples, one (1) from the East near shore bank and one (1) from the West near shore bank, collected along a cross section, about half-way between the confluence of the East Fork and the South Fork from within the post drawdown 1400' pool. Because this material exceeds the SL guidelines, and is currently exposed to the water, it may require management. Best management practices in this case would likely be to allow natural attenuation (natural capping) to take place over time. Earlier testing of the lakebed sediments, prior to the drawdown, in the1996 sampling event were non-detect for Σ DDT. As part of the management strategy for this sediment it will likely include future sampling of this area after the construction period, when all drawdown and further erosion factors are complete, to determine if natural attenuation is effectively isolating the Σ DDT from benthic organisms exposure. Future erosion events will, also, potentially cover this sediment with new deposits that will need to be tested for Σ DDT levels.

The biggest potential for a future release of Σ DDT from Cougar Reservoir comes from the re-suspending and re-distribution of sediments currently exposed during the initial drawdown event. Vertical profile samples indicate sediments in former deposit sites contain Σ DDT above guideline SLs. As stated earlier, future sampling will need to be done to determine if Σ DDT is exposed within the pool from future erosive action.

Alternatives for pool depth (1400' vs. 1532'), drawdown rate (3'/day vs. 6'/day) and target date for reaching the 1400-foot level (March 1 vs. April 1) were discussed. The decision to keep the pool as close to the 1400-foot level as possible, after allowing pool elevation to rise to 1450' for protection of Bull Trout spawning, with a return to 1400' starting on December 1, 2002, was elected as the best management alternative. The differences between the pool level alternatives would likely have little effect on Σ DDT being released downstream. It is difficult to know which alternative might result in the greater re-suspending and re-distribution of sediments, but it is very unlikely that any erosion that occurs will cause greater suspending and distribution of sediments than the original event, which did not result in a measurable release in the sediment tested downstream of the dam.

Turbidity particulate and possibly some bedload sediment monitoring is recommended during the winter and spring seasons. Because Σ DDT binds to the finer-grained sediment particles and organic material, it is recommended that these fine-grained materials be monitored. While a sampling and analysis plan will need to be developed, it would likely include areas above and below the reservoir, upstream and downstream of the confluence of the South Fork and the Mainstem of the McKenzie River, with other possible areas to be determined.

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[1] Dredge Material Evaluation Framework – Screening level for open water disposal 6.9 ug/kg total DDT.

[2] Oregon Department of Environmental Quality – Level II screening level 7.0 ug/kg total DDT.

[3] See Attachment A & B for complete Sampling and Analysis Plans

[4] Oregon Department of Environmental Quality - Upland Soil Cleanup Table (OAR 340-122-045 for Total DDT = 7000 ug/kg – ppb; (DDD = 3000 ppb; DDE = 2000 ppb & DDT = 2000 ppb).

Table 3. Cougar Temperature Control Project **Sampled June 4-5, 2002**

Physical Analysis

Sample I.D.	Grain Size (mm)		Percent			mg/Kg
	Median	Mean	Gravel	Sand	Silt/Clay	Volatile Solids
COUG-G-01	0.040	0.044	0.0	22.3	77.7	67200
COUG-G-02	0.032	0.033	0.0	13.3	86.7	57000
COUG-G-03	0.030	0.032	0.0	10.9	89.1	73000
COUG-G-04	0.040	0.047	0.0	27.1	72.9	69500
COUG-G-05	0.028	0.033	0.0	15.6	84.4	56800
COUG-G-06	0.094	0.093	0.0	73.0	27.0	82200
COUG-G-07	0.007	0.012	0.0	10.7	89.3	51300
COUG-G-08	0.017	0.023	0.1	6.0	93.9	54300
COUG-G-09	0.080	0.093	0.0	61.5	38.5	64500
COUG-G-10	0.008	0.014	0.0	3.2	96.8	72700
COUG-G-11	0.008	0.016	0.0	3.4	96.6	25600
COUG-G-13	0.027	0.034	0.6	16.9	82.5	68200
Mean	0.034	0.040	0.06	22.0	78.0	61858
Minimum	0.007	0.012	0.0	3.2	27.0	25600
Maximum	0.094	0.093	0.6	73.0	96.8	82200

Inorganic Metals and TOC

Sample I.D.	As	Sb	Fe	Cd	Cu	Pb	Hg	Ni	Ag	Zn	TOC
	mg/kg (ppm)										
COUG-G-05	0.81J	0.37J B1	26500	<0.01	49.1B2	4.7B2	<0.022	41.1	0.23JB2	67.5B2	22400
COUG-G-07	2.25	2.4JB2	32900	<0.01	56B2	5.9B2	0.033	37.5	0.22JB2	62.3B2	10800
* COUG-G-07A	1.8	0.3	40900	0.42	53.2	4.9	<0.03	37.3	0.5	60.7	16800
COUG-G-09	1.1J	1.9JB1	13400	<0.02	25.7B2	3.5B2	0.04J	19	0.19JB2	32.5B1	103000
COUG-G-11	3.5	1.12JB1	36300	<0.01	44.3B2	11.5B2	0.05	25.7	0.36JB2	86.9B2	25700
COUG-G-13	2.7	0.68JB1	29500	<0.01	37.6B2	7.3B2	0.04	23	0.32JB2	62.1B2	20700
Screening level (SL) DMEF	57	150	+	5.1	390	450	0.41	140	6.1	410	
Screening level (SL) DEQ Level II	6	+	+	0.6	36	35	0.2	18	4.5	123	

+ No screening level established

* COUG-G-07A is the Quality Assurance lab sample splint for COUG-G-07

J = Estimated value (reported values are above the MDL, but below the PQL).

B1 = Low-level contamination was present in the method blank (reported level was < 10 times blank concentration).

B2 = Low-level contamination was present in the method blank (reported level was > 10 times blank concentration).

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).

Pesticides, PCBs*, Phenols**, Phthalates and Extractables**

Sample I.D.	Pesticides				Phthalates		Herbicides
	ug/kg (ppb)						
	4,4'-DDD	**4,4'-DDE**	**4,4'-DDT**	**Total DDT**	**bis(2-Ethylhexyl) phthalate**	**3 & 4 Methyl phenol**	**N-nitroso-di-n-propylamine**
COUG-G-05	13.3	8.15	2.42 J	23.9	<78.6	<5.4	<2.5
COUG-G-07	3.38	3.7	1.45	8.5	<78.6	<5.4	32.4
* COUG-G-07A	1.10	0.616	<0.487	1.72	<28	<44	<22
COUG-G-09	17.9	6.34	8.39	32.6	<78.6	17.8	<2.5
COUG-G-11	2.75 J	2.57 J	<0.36	5.32	<78.6	<5.4	<2.5
COUG-G-13	9.62	6.06	2.93 J	18.6	110 J	<5.4	<2.5
Screening Level DMEF	DDD +	DDE +	DDT +	= 6.9ppb	8300	670	28
Screening Level DEQ Level II	4 +	1.5 +	4 +	= 7.0ppb	750	100	No freshwater value, marine number is 28

***No PCBs** were found in any sample at the MDL (<3.65ppb) (SL = 130 ppb).
****No Phenols or Extractables** were found in any sample at their respective MDLs.
* COUG-G-07A is the Quality Assurance lab sample splint for COUG-G-07
J = Estimated value (reported values are above the MDL, but below the PQL).
No other Pesticides or herbicides were detected at MDL
Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).
All Total DDT values underwent second column confirmation.

Polynuclear Aromatic Hydrocarbons (PAHs)

Low Molecular Weight Analytes

ug/kg (ppb)

Sample I.D.	Acenaphthene	Acenaphthylene	Anthracene	Fluorene	2-Methyl naphthalene	Naphthalene	Phen-anthrene	Total Low PAHs
COUG-G-05	<10.6	<9.4	<5.4	<10	<3.4	<10.1	<4.6	ND
COUG-G-07	<10.6	<9.4	<5.4	<10	<3.4	<10.1	<4.6	ND
* COUG-G-07A	<29.0	<19.0	<29.0	<19.0	<31.0	<50.0	<34.0	ND
COUG-G-09	<10.6	<9.4	<5.4	<10	<3.4	<10.1	<4.6	ND
COUG-G-11	<10.6	<9.4	<5.4	<10	<3.4	<10.1	<4.6	ND
COUG-G-13	<10.6	<9.4	<5.4	<10	<3.4	<10.1	<4.6	ND
Screen level (SL) DMEF	500	560	960	540	670	2100	1500	5200
Screen level (SL) DEQ Level II	57	160	57	77	+	176	42	76

* COUG-G-07A is the Quality Assurance lab sample splint for COUG-G-07
Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit)

Polynuclear Aromatic Hydrocarbons (PAHs)

High Molecular Weight Analytes

ug/kg (ppb)

Sample I.D.	Benzo(b)-fluro-anthene	Benzo(k)-fluro-anthene	Benzo-(g,h,i)-perylene	Chrysene	Pyrene	Benzo(a)-pyrene	Indeno-(1,2,3-cd)-pyrene	Fluor-anthene	Total High PAHs
COUG-G-05	<9.5	<9.5	<3.6	<12.6	<7.1	<12.6	<5.0	<10.0	ND
COUG-G-07	<9.5	<9.5	<3.6	<12.6	<7.1	<12.6	<5.0	<10.0	ND
* COUG-G-07A	<39.0	<39.0	<32.0	<29.0	<25.0	<41.0	<30.0	<33.0	ND
COUG-G-09	<9.5	<9.5	<3.6	<12.6	<7.1	<12.6	<5.0	<10.0	ND
COUG-G-11	<9.5	<9.5	<3.6	<12.6	<7.1	<12.6	<5.0	<10.0	ND
COUG-G-13	<9.5	<9.5	<3.6	<12.6	<7.1	<12.6	<5.0	<10.0	ND
Screen level (SL) DMEF	b + k = 3200		670	1400	2600	1600	600	1700	12000
Screen level (SL) DEQ Level II	+	27	300	57	53	32	17	111	193

* COUG-G-07A is the Quality Assurance lab sample splint for COUG-G-07
J = Estimated value (reported values are above the MDL, but below the PQL).
Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).

Physical Analysis

Sample I.D.	Grain Size (mm)		Percent			mg/kg
	Median	Mean	Gravel	Sand	Silt/Clay	Volatile Solids
COUG-G-14	1.60	4.73	71.83	24.08	4.09	3190
COUG-G-15	1.20	3.74	42.89	49.94	7.17	3120
COUG-G-16	1.30	3.85	42.82	54.56	2.62	1390
COUG-G-17	0.59	0.36	0.00	98.44	1.56	3040
COUG-G-18	0.07	0.09	0.00	55.27	44.73	53700
COUG-G-19	1.20	4.44	46.20	41.97	11.82	7420
COUG-G-20	0.11	0.11	0.00	77.43	22.57	7470
COUG-G-21	0.12	0.11	0.00	72.20	27.80	5890
COUG-G-22	0.07	0.07	0.00	56.90	43.10	10100
COUG-G-23	0.09	0.07	0.00	61.74	38.26	14710
COUG-G-24	0.04	0.04	0.00	20.08	79.92	10630
COUG-G-25	0.03	0.04	0.00	21.55	78.45	8200
COUG-G-26	0.02	0.04	0.00	13.87	86.13	11980
COUG-G-27	0.04	0.31	4.05	35.11	60.84	8420
COUG-G-28	0.05	0.07	0.00	42.75	57.25	9330
Mean	0.47	1.29	14.8	51.85	40.45	11330
Minimum	0.02	0.04	0.00	13.87	1.56	1390
Maximum	1.60	4.73	71.83	98.44	86.13	53700

Table 9. Cougar Temperature Control **Sampled August 6-7, 2002**

Total DDT With Breakdown Products & Total Organic Carbon

ug/kg (ppb)

Location & Date Sampled	Description	Sample ID	DDD	DDE	DDT	Total DDT	TOC
			ug/kg (ppb)				mg/kg
DOWNSTREAM OF DAM Sampled August 6-7, 2002	Downriver by Powerhouse	COUG-G-14	<0.485	<0.574	<0.646	ND	16600
	Downriver by Gauging Station	COUG-G-15	<0.397	<0.469	<0.528	ND	6130

Location & Date Sampled	Description	Sample ID	DDD	DDE	DDT	Total DDT	TOC
UPSTREAM OF RESERVOIR Sampled August 6-7, 2002	Upriver South Fork (South of bridge)	COUG-G-16	<0.189	<0.223	<0.252	ND	1180
	Upriver South Fork (South of bridge)	COUG-G-17	<0.174	<0.206	<0.232	ND	6780

Location & Date Sampled	Description	Sample ID	DDD	DDE	DDT	Total DDT	TOC
UPLAND ABOVE RESERVOIR[4] Sampled August 6-7, 2002	Upland above reservoir - top 6" of 12" of forest floor	COUG-G-18	1.76 J	84.6	290	376.4	240000
	Upland above reservoir - bottom 6" of 12" of forest floor	COUG-G-19	<0.28	11.2	25.7	36.9	107000

Location & Date Sampled	Description	Sample ID	DDD	DDE	DDT	Total DDT	TOC
SLIDE CREEK BANK DEPOSIT Sampled August 6-7, 2002	South Fork - Slide Creek, Vertical profile of COUG-G-06	COUG-G-20	4.76	2.51	<0.319	7.27	29100
	South Fork - Slide Creek, Vertical profile of COUG-G-05	COUG-G-21	3.62	2.63J	0.856J	7.11	20800

Table 9. Cougar Temperature Control **Sampled August 6-7, 2002**

Total DDT With Breakdown Products & Total Organic Carbon

ug/kg (ppb)

SLIDE CREEK BANK DEPOSIT Sampled June 4-5, 2002	South Fork - Slide Creek	COUG-G-05	13.3	8.15	2.42J	23.9	22400
EAST FORK BANK DEPOSIT Sampled August 6-7, 2002	East Fork, Vertical profile of COUG-G-07	COUG-G-22	8.57	7.22	1.86J	17.65	30000
EAST FORK BANK DEPOSIT Sampled June 4-5, 2002	East Fork - target fine grain sediment	COUG-G-07	3.38	3.7	1.45	8.5	10800

EAST FORK BANK DEPOSIT Sampled August 6-7, 2002	East fork - Organic layer, Vertical profile of COUG-G-09	COUG-G-23	8.91	5.84	1.41J	16.16	64700
	QC Split of COUG-G-23 - Blind Duplicate	COUG-G-A	9.78	5.37	3.64	18.79	56900
	QA Split of COUG-G-23 -Duplicate to different laboratory	COUG-G-23QA	7.07J	5.59J	<2.24	12.66	54600
EAST FORK BANK DEPOSIT Sampled June 4-5, 2002	East fork - Target organic layer	COUG-G-09	17.9	6.34	8.39	32.6	103000

RESERVOIR POOL COMPOSITE SAMPLE Sampled August 6-7, 2002	East Fork - drawdown pool (Composite of 3 grabs)	COUG-G-24	2.11J	2.66J	<0.617	4.77	25800
	QC Split of COUG-G-24 - Blind Duplicate	COUG-G-B	1.48J	3.23J	<0.573	4.71	26600
	QA Split of COUG-G-24 - Duplicate to different laboratory	COUG-G-24QA	2.11J	3.87J	<2.83	5.98	32100

Table 9. Cougar Temperature Control **Sampled August 6-7, 2002**

Total DDT With Breakdown Products & Total Organic Carbon

ug/kg (ppb)

RESERVOIR POOL COMPOSITE SAMPLE Sampled August 6-7, 2002	South Fork - drawdown pool (Composite of 3 grabs)	COUG-G-25	3.11J	3.08J	<0.497	6.19	18200
RESERVOIR POOL COMPOSITE SAMPLE Sampled August 6-7, 2002	Halfway between S. Fork & E. Fork (Composite of 2 grabs)	COUG-G-26	12	4.62J	9.25	25.87	23300
RESERVOIR POOL COMPOSITE SAMPLE Sampled August 6-7, 2002	Around outlet to diversion tunnel (Composite of 3 grabs)	COUG-G-27	<0.437	1.08J	<0.582	1.08	15600
RESERVOIR POOL COMPOSITE SAMPLE Sampled August 6-7, 2002	East side of Reservoir at dam (Composite of 3 grabs)	COUG-G-28	<0.462	<0.547	<0.615	ND	13600

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[4] Oregon Department of Environmental Quality - Upland Soil Cleanup Table (OAR 340-122-045) for Total DDT = 7000 ug/kg – ppb; (DDD = 3000 ppb; DDE = 2000 ppb & DDT = 2000 ppb).

Sample Station Site Map
Collected June 4-5 & August 6-7, 2002

Attachment A

SEDIMENT
SAMPLING & ANALYSIS
PLAN FOR THE
COUGAR TEMPERATURE CONTROL PROJECT

MAY 2002

Prepared by:

CENWP-EC-HR

Portland District Corps of Engineers

Attachment A

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SAMPLING & ANALYSIS PLAN FOR THE COUGAR TEMPERATURE CONTROL PROJECT

1.0 PROJECT DESCRIPTION, SITE HISTORY AND ASSESSMENT

1.1 Project Site Description and Location: The Cougar Project is located on the South Fork of the McKenzie River, 4.4 miles upstream from the confluence with the McKenzie River. The project is 61 river miles (RM) upstream from the mouth of the McKenzie River (Willamette River RM 170.8). Cougar Dam is a rock-fill embankment about 1,600 feet long and 450 feet high from average tailwater to crest of dam. The project controls runoff from a drainage area of 210 square miles of mountainous and timbered land. The purpose of the proposed Willamette Temperature Control project is to modify temperatures for the Cougar and Blue River Projects through a structure addition to the existing intake that will regulate outlet through selective withdrawal to modify the temperature of downstream water released, to replicate a natural cycle of water temperatures, for the benefit of anadromous and native fish species.

Prior to construction of the multilevel withdrawal system, the reservoir level will be lowered to EI. 1400 NGVD (National Geodetic Vertical Datum), which is below minimum power pool El. of 1516 NGVD and full pool El. of 1699 NGVD (original plan called for pool to be lowered to 1375').

1.2 Site History: During the drawdown process, erosion of the [me-grained sediment delta areas formed where tributaries enter the reservoir has occurred. The eroded sediments are causing turbidity concerns within and downstream of the reservoir. In addition to the concerns of turbidity levels, the question of possible distribution of contamination contained within the sediments has arisen. Members of the public expressed concern for the presences of some heavy metals and the use of the herbicide Atrazine in areas upstream of the reservoir. There is no historical evidence that a source of contamination exists or has existed in the past in the areas upstream of the reservoir. However, due to the large amounts of sediment being eroded and the concerns expressed, sampling has been scheduled.

1.3 Previous Sediment Sampling: In February of 1996 twelve (12) sediment samples were submitted by Geotechnical Resources Inc. to the Corp's materials lab and Sound Analytical Services laboratory and for physical and chemical analyses. Physical parameters included soil classification, particle size and dredge test analysis, with analysis varying from 80% gravel to 90% silt. Chemical methods TPH-HCID (petroleum hydrocarbon identification) with quantification for gasoline, TPH-418.1, 8 RCRA metals, 1311 TCLP, EPA 200.8,7471 (lead), 8080 (pest/PCB) and TOC (total organic carbon) were performed on select samples. No organic contaminates were detected above method detection levels (MDL) and metals were detected only at low levels and are considered at background. The laboratory encountered some minor problems with matrix interferences causing recovery levels for several surrogate analyses to be outside the recommended range. These problems are considered minor and do not affect the confidence on the over all data objectives.

2.0 SAMPLING AND ANALYSIS OBJECTIVES

- To characterize sediments in accordance with the regional dredge material testing manual, the Dredge Material Evaluation Framework for the Lower Columbia River Management Area (DMEF).

- Collect, handle and analyze representative sediments, from the exposed surface adjacent to the sediments eroded during drawdown, in accordance with protocols and Quality Assurance/Quality Control *(QNQC)* requirements.

- Characterize sediments for evaluation of environmental impact due to contamination.

- Conduct physical and chemical characterization only, for this sediment evaluation.

3.0 SAMPLING AND ANALYSIS REQUIREMENTS

3.1 Project Ranking: Ranking does not apply to this sampling plan,

3.2 Sampling and Analysis Requirements: Sampling is being scheduled at the sediment deltas that are being effected the most by the draw down. The areas containing fine-grained sediment will be targeted. A vertical profile sample will be collected from the bank of the eroded area (this will simulate a core sample).

4.0 SAMPLE COLLECTION AND HANDLING PROCEDURES

4.1 Sampling Locations and Numbering: Figure 1 shows the project and general sample location areas. Sampling sites are located for the best characterization of the material being eroded as possible. Proper QA/QC procedures as outlined in this section will be followed. Any deviation from these procedures shall be noted in the field log. Sample identification shall follow the following convention:

COUR-X- YY

Where, "COUR" denotes samples collected from the Cougar Reservoir, "X" denotes the type of sampling such as "G" = grab; "YY" denotes the numeric sample sequence number and will consist of two digits for all samples, except composites (i.e. 01,05, 15, etc.). The QC replicates will have a letter designation in place of the numeric designation of the primary sample; e.g. "A" added (CS-GC- A). Duplicate samples will be identified in the field notes.

4.2 Field Sampling Schedule: Sampling is planned for May 2002.

4.3 Field Notes: Field notes will be maintained during sampling and compositing operations. Included in the field notes will be the following:

- Names of the person(s) collecting and logging in the samples.
- Weather conditions.
- Depth of each station sampled as measured from the water surface. This will be accomplished using a leadline or corrected depth recorder.
- Date and time of collection of each sediment sample.
- The sample station number and individual designation numbers assigned for each individual sample.
- Descriptions of sediment or core sections.
- Vertical profile (simulated cores) will be measured and described.
- Any deviation from the approved sampling plan.

4.4 Positioning: Sampling locations will be recorded in the field. Horizontal coordinates will be referenced to the Oregon Coordinate System for proper North or South Zones NAD 83 (North American Datum 1983). Horizontal coordinates will be identified as latitude and longitude to the nearest 0.1 second.

4.5 Decontamination: All sampling devices and utensils will be thoroughly cleaned prior to use according to the following procedure:

- Wash with brush and A1conox soap
- Rinse with distilled water
- Rinse with 10% HC1 solution
- Rinse with distilled water

Utensils used to collect physical samples only will not require the cleaning procedure listed. All utensils used to collect chemical samples will require decontamination prior to each use. All handwork for chemical analyses will be conducted with disposable latex gloves, which will be rinsed with distilled water before and after handling each individual sample, as appropriate, to prevent sample contamination. Gloves will be disposed of between samples or composites to prevent cross contamination between samples.

4.6 Core Log Each discrete core (simulated core) section will be inspected and described. For each core sample, the following data will be recorded on the core log as they apply:
Sample recovery
Physical soil description (includes soil type, density/consistency of soil, color) Odor (e.g., hydrogen sulfide, petroleum products) Visual stratification and lenses Vegetation
Debris
Biological Activity (e.g., detritus, shells, tubes, bioturbation, live or dead organisms) Presence of oil sheen
Any other distinguishing characteristics or features

4.7 Field Compositing: No composite samples are planned for this project.

4.8 Field ReD1icates: One project sample will be subjected to a three way split, with two portions submitted to the project lab (one with a blind duplicate ID) and the third portion submitted to a second laboratory as a quality assurance (QA) sample.
4.9 Sample Transport and Chain-of-Custody Procedures: After sample containers have been filled, they will be packed in ice or "blue ice" in coolers. Chain-or-custody procedures will commence in the field and will track delivery of the samples. Sample holding times and storage requirements are presented in Table 1. Specific procedures are as follows:
Samples will be packaged and shipped in accordance with U.S. Department of Transportation regulations as specified in 49 CFR 173.6 and 49 CFR 173.24 or delivered directly to the testing Laboratory.
Individual sample containers will be packed to prevent breakage.
The coolers will be clearly labeled with sufficient information (name of project, time and date container was sealed, person sealing the cooler and office name and address) to enable positive identification.
Chain-of -custody forms will be enclosed in a plastic bag and placed inside cooler.

Upon transfer of sample possession to the laboratory, the persons transferring custody of the coolers will sign the chain-of-custody form. Upon receipt of samples at the laboratory, the coolers will be inspected and the receiver will record the condition of the samples.

Table 1, Sample Volume and Storage

Sample Type	Holding Time	Sample Size (a)	Temperature (b)	Container
Particle Size	6 Months	200 g	4ºC	1-1 Quart Plastic Bag
PAHs, Phenols, Phthalates, Misc. Extractables, Chlorinated Organic Compounds	14 Days	125 g	4ºC	1-1 Liter Glass (combined)
Total Organic Carbon	14 Days	125 g	4ºC	
Mercury	28 Days	5g	4ºC	
Metals (except Mercury)	6 Months	50 g	4ºC	
Pesticides and PCBs	14 Days	10 g	4ºC	

a. Required sample sizes for one laboratory analysis. Actual volumes to be collected have been increased to provide a margin of error and allow for retest.
b. During transport to the lab, samples will be stored on ice.

5.0 LABORATORY PHYSICAL AND CHEMICAL SEDIMENT ANALYSIS

5.1 Laboratory Analyses Protocols. Laboratory testing procedures will be conducted in accordance with the DMEF. The samples will be analyzed for all the parameters listed in sections 5.1.3 and 5.1.4 as requested on the chain-of-custody record. Private contract analytical chemical laboratories will conduct all physical and chemical analyses.

5.1.1 Chain-of-Custody: A chain-of-custody record for each set of samples will be maintained throughout all sampling activities and will accompany samples and shipment to the laboratory. Information tracked by the chain-of-custody records in the laboratory include sample identification number, date and time of sample receipt, analytical parameters required, location and conditions of storage, date and time of removal from and return to storage, signature of person removing and returning the sample, reason for removing from storage, and final disposition of the sample.

5.1.2 Limits of Detection: Detection limits of all chemicals of concern must be below screening levels. All reasonable means, including additional cleanup steps and method modifications, will be used to bring all limits-of-detection below the screening levels.

5.1.3 Sediment Chemistry: Private analytical laboratories will conduct all chemical analyses. Chemical analyses will include: metals (6020/7470 or 7471), total organic carbon (TOC) method 9060, polynuclear aromatic hydrocarbons (PAHs), phenols, phthalates, chlorinated organic compounds, misc. extractables with Atrazine by 8270 SIM method or other low level detection method, pesticides/PCBs by 8081/8082 and chlorinated herbicides by method 8151.

5.1.4 Sediment Conventionals: The private analytical laboratories will analyze physical parameters. Particle grain size distribution for each sample will be determined. Sieve analysis will use a geological sieve series, which will include the sieve sizes U.S. NO.5, 10, 18,35,60, 120, and 230. Hydrogen peroxide will not be used in preparations for grain-size analysis. Hydrometer analysis will be used for particle sizes finer than the 230 mesh. Water content will be determined using ASTM D 2216. Sediment classification designation will be made in accordance with U.S. Soil Classification System, ASTM D 2487.

5.1.5 Holding Times: To the maximum extent practicable all chemical results will be provided within 7 -14 days of receipt. All samples for physical and chemical testing will be maintained at the testing laboratory at the temperatures specified in Table 1 and analyzed within the holding times shown in the table.

5.1.6 Quality Assurance/Quality Control: The chemistry QA/QC procedures found in Table 2 will be followed.

5.2 Laboratory Written Resort: The analytical laboratory documenting all the activities associated with sample analyses will prepare a written report. As a minimum, the following will be included in the report:

Results of the laboratory analyses and *QA/QC* results. All protocols used during analyses.
Chain of custody procedures, including explanation of any deviation from those identified herein. Any protocol deviations from the approved sampling plan. Location and availability of data.
As appropriate, this sampling plan may be referenced in describing protocols.

Table 2, Minimum Laboratory

Analytical Type	Method Blank[2]	Duplicate[2]	RM[2,4]	Matrix Spikes[2]	Surrogates[7]
Semivolatiles[1]	X	X[3]	X[5]	X	X
Pesticides/PCBs[1]	X	X[3]	X[5]	X	X
Metals	X	X	X[6]	X	
Total Organic Carbon	X	X	X[6]		
Total Solids		X			
Total Volatile Solids		X			
Particle Size		X			

1. Initial calibration required before any samples are analyzed, after each major disruption of equipment, and when ongoing calibration fails to meet criteria. Ongoing calibration required at the beginning of each work shift, every 10-12 samples or every 12 hours (whichever is more frequent), and at the end of each shift.
2. Frequency of Analysis = one per batch 3. Matrix spike duplicate will be run 4. Reference Material
5. Canadian standard SRM-l
6. NIST certified reference material 2704
7. Surrogate spikes will be included with every sample, including matrix-spiked samples, blanks and reference materials

6.0 **BIOLOGICAL TESTING**

Bioassays are not planned for this sampling event.

7.0 **REPORTING**

7.1 OA Report: The laboratory QA/QC reports will be incorporated by reference. This report will identify any laboratory activities that deviated from the approved protocols and will make a statement regarding the overall validity of the data collected.

7.2 Sediment Evaluation Report: A written discussion of findings shall be prepared documenting the physical and chemical character of potential material to be dredged. The physical and chemical reports will be included as reference; individual copies will be furnished as requested. As a minimum, the following will be included in the
Previous sampling and analyses.
Locations where the sediment samples were collected.
A plan view of the project showing the actual sampling location. Description of sampling.
Chemical testing data, with comparisons to screening levels guidelines. Biological testing data and evaluation based on the DMEF manual.

SAMPLING & ANALYSIS PLAN FOR THE COUGAR TEMPERATURE CONTROL PROJECT

APPENDIX A

PARAMETERS AND METHODS

1. Recommended Sample Preparation Methods, Cleanup Methods, Analytical Methods and Detection Limits for Sediment Management Standards, Chapter 173-204 WAC, Draft -July 1996.

2. Recommended Protocols for Measuring Conventional Sediment Variables in Puget Sound, Puget Sound Estuary Program, March 1986.

3. Recommended Methods for Measuring TOC in Sediments, Kathryn Bragdon-Cook, Clarification Paper, Puget Sound Dredged Disposal Analysis Annual Review, May 1993.

4. Units: ug = microgram, mg = milligram, kg = kilogram, DW = dry weight, oc = organic carbon.

5. Test Methods for Evaluating Solid Waste. Laboratory manual physical & chemical methods. Method 3050, SW-846, 3rd ed., Vol. lA, Chapter 3, Sec 3.2, Rev 1. Office of Solid Waste and Emergency Response, Washington, DC.

6. Graphite Furnace Atomic Absorption (GFAA) Spectrometry -SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.

7. Inductively Coupled Plasma (ICP) Emission Spectrometry -SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.

8. Test Methods for Evaluating Solid Waste. Laboratory manual physical/chemical methods. Method 7471, SW-846, 3rd ed., Vol. lA, Chapter 3, Sec 3.3. Office of Solid Waste and Emergency Response, Washington, DC.

9. Sonication Extraction of Sample Solids -Method 3550 (Modified), SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986. Method is modified to add matrix spikes before the dehydration step rather than after the dehydration step.

10. GCMS Capillary Column -Method 8270, SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EP A 1986.

11. Purge and Trap Extraction and GCMS Analysis -Method 8260, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.

12. Soxh1et Extraction and Method 8081, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EP A 1986.

13. Total PCBs BT value in ffig/kg oc.

QA2 DATA REQUIREMENTS

CHEMICAL VARIABLES

ORGANIC COMPOUNDS

The following documentation is needed for organic compounds:

A cover letter referencing or describing the procedure used and discussing any analytical problems

Reconstructed ion chromatograms for GC/MS analyses for each sample

Mass spectra of detected target compounds (GC/MS) for each sample and associated library spectra

GC/ECD and/or GC/flame ionization detection chromatograms for each sample

Raw data quantification reports for each sample

A calibration data summary reporting calibration range used [and decafluorotriphenylphosphine (DFTPP) and bromofluorobenzene (BFB) spectra and quantification report for GC/MS analyses]

Final dilution volumes, sample size, wet-to-dry ratios, and instrument detection limit

Analyte concentrations with reporting units identified (to two significant figures unless otherwise justified)

Quantification of all analytes in method blanks (ng/sample)

Method blanks associated with each sample

Recovery assessments and a replicate sample summary (laboratories should report all surrogate spike recovery data for each sample; a statement of the range of recoveries should be included in reports using these data)

Data qualification codes and their definitions, METALS

For metals, the data report package for analyses of each sample should include the following:

Tabulated results in units as specified for each matrix in the analytical protocols, validated and signed in original by the laboratory manager

Any data qualifications and explanation for any variance from the analytical protocols

Results for all of the QA/QC checks initiated by the laboratory

Tabulation of instrument and method detection limits.

All contract laboratories are required to submit metals results that are supported by sufficient backup data and quality assurance results to enable independent QA reviewers to conclusively determine the quality of the data. The laboratories should be able to supply legible photocopies of original data sheets with sufficient information to unequivocally identify:

Calibration results

Calibration and preparation blanks

Samples and dilutions

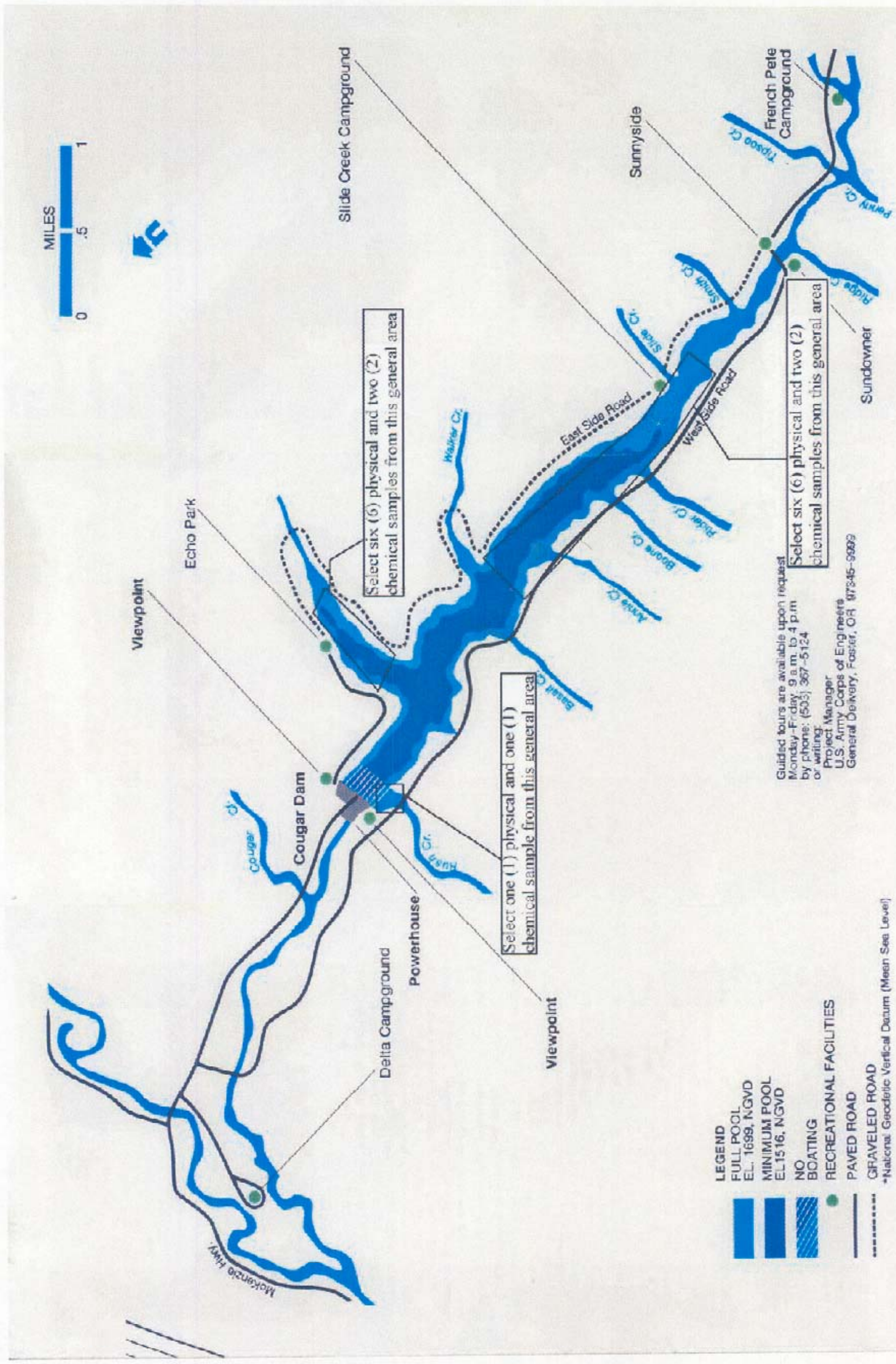
Duplicates and spikes

Any anomalies in instrument performance or unusual instrumental adjustments.

Attachment A
June 2002, Sampling and Analysis Plan

Figure 1, Cougar Temperature Control Structure

Proposed Sediment Sampling Sites



10

Attachment B

SEDIMENT
SAMPLING & ANALYSIS PLAN
FOR THE
COUGAR TEMPERATURE CONTROL PROJECT

August 2002

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Portland District
Corps of Engineers

Cougar Reservoir Temperature Control Project
Sampling and Analysis Plan

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1.0 PROJECT DESCRIPTION, SITE HISTORY AND ASSESSMENT

1.1 Project Site Description and Location:

The Cougar Project is located on the South Fork of the McKenzie River, 4.4 miles upstream from the confluence with the McKenzie River. The project is 61 river miles (RM) upstream from the mouth of the McKenzie River (Willamette River RM 170.8). Cougar Dam is a rock-fill embankment about 1,600 feet long and 450 feet high from average tailwater to crest of dam. The project controls runoff from a drainage area of 210 square miles of mountainous and timbered land. The purpose of the proposed Willamette Temperature Control project is to modify temperatures for the Cougar and Blue River Projects through a structure addition to the existing intake that will regulate outlet through selective withdrawal to modify the temperature of downstream water released, to replicate a natural cycle of water temperatures, for the benefit of anadromous and native fish species.

Prior to construction of the multilevel withdrawal system, the reservoir level was lowered to El. 1400 NGVD (National Geodetic Vertical Datum), which is below minimum power pool El. of 1532 NGVD and full pool El. of 1699 NGVD (original plan called for pool to be lowered to 1375').

1.2 Site History:

During the drawdown process, erosion of the fine-grained sediment delta areas, where tributaries enter the reservoir, had occurred. The eroded sediments caused turbidity concerns within and downstream of the reservoir. In addition to the concerns of turbidity levels, the question of possible distribution of contamination contained within the sediments was raised. Of the over 70 contaminates analyzed for, Dichlorodiphenyltrichloroethane (DDT) and its breakdown products, were the only contaminates detected at levels of concern; levels detected are listed in section 1.3, under the heading: June 4-5, 2002 sampling event. N-nitroso-di-n-propylamine (DPN) was detected in one primary lab quality control (QC) sample, but was not detected in the duplicate quality assurance (QA) lab sample or in any of the other samples at low detection levels. DNP is produced primarily for research and usually not for commercial purposes. It is water-soluble and has only a slight tendency to sorb to suspended organic matter, biota and sediments (ref. Spectrum Laboratories: Chemical fact sheet – Cas # 6216647). It is questionable if DNP actually is present in the sample and is not being considered further as a contaminate-of-concern.

1.3 Previous Sediment Sampling:

February 1996

Twelve (12) sediment samples were collected by Geotechnical Resources Inc. and submitted to the Corp's materials lab and Sound Analytical Services laboratory for physical and chemical analyses. Physical parameters included soil classification, particle size and dredge test analysis, with analysis varying from 80% gravel to 90% silt. Chemical methods TPH-HCID (total petroleum hydrocarbon identification) with quantification for gasoline, TPH-418.1, 8 RCRA (Resource Conservation and Recovery Act) metals, 1311 TCLP (toxicity characteristic leaching procedure), EPA 200.8, 7471 (lead), 8080 (pest/PCB) and TOC (total organic carbon) were performed on select samples. No organic contaminates were detected above method detection levels (MDL) and metals were detected only at low levels and are considered at background. The laboratory encountered some minor problems with matrix interferences causing recovery levels for several surrogate analyses to be outside the recommended range. These problems are considered minor and do not affect the confidence on the over all data objectives.

June 4-5, 2002 Sampling Event

Because most contaminates-of-concern bind to fine-grained sediment and organic material, they were the targeted sediments in the June 4-5 sampling event, which may not be the best representation of all the sediments that eroded. The logic behind the first event was to find the contaminants, if they were present, then determine how much of the entire eroded volume they represented and further determine if the level detected presented a significant environmental risk and what actions, can or should be taken.

Sediment for twelve (12) physical and five (5) chemical analyses were collected from delta areas. The following areas were selected for chemical analyses, two (2) samples were collected from East Fork cut banks (DDT @ 8.5 & 32.6 ppb), one (1) sample below the Slide Creek boat ramp, from a delta cut bank (DDT @ 23.9 ppb), one (1) sample from the Annie Creek delta (DDT @ 18.6 ppb), and one (1) sample was collected from lake deposits near the face of the dam on the Rush Creek side (DDT @ 5.3 ppb). Physical parameters included soil classification; particle size and a suite of dredge testing analyses. Chemical analyses included: (RCRA) heavy metals (6020/7470 or 7471), total organic carbon (TOC) method 9060, polynuclear aromatic hydrocarbons (PAHs), phenols, phthalates, chlorinated organic compounds, misc. extractables by 8270 SIM method (low level detection method), pesticides/PCBs by 8081/8082 and chlorinated herbicides by method 8151. Severn Trent Laboratory in Tacoma analyzed the samples. No contaminants were detected at levels of concern, except total DDT at levels indicated above.

1.4 Proposed Sediment Sampling Event (Follow-up to DDT found June 4-5, 2002)

Though the levels of DDT detected in the June 4-5 sampling event are at a level of concern for the health of benthic organisms, it has not yet been determined if those levels represent the entire volume of material that has been eroded. Due to the detection of DDT in these samples, the next sampling event will attempt to answer the following questions, with the associated sampling action.

Question: What levels of DDT are in the background?

Action: Collect up to two (2) background sediment samples from above the reservoir on the South Fork of the McKenzie to establish a baseline. An additional sample will be collected from the forest floor organic material above the reservoir and analyzed in at least two (2) vertical lifts.

Question: What levels of DDT are represented in the total volume of sediment eroded and sediment that has a potential for future erosion?

Action: Collect up to five (5) vertical profile samples from the cut bank areas where only the fine-grained sediment was targeted in the first sampling event in June. Fresh sediments will be exposed prior to sampling from the cut banks.

Question: What levels of DDT are currently exposed in the reservoir?

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Action: Collect up to five (5) surface sediment samples for analyses, from sediment that has recently been eroded and homogenized during the drawdown even, from all the newly formed delta areas in the current reservoir (1400-foot elevation). Each sample submitted for analysis will consist of three (3) composite surface grab samples, using a ponar sampling devise.

Question: What levels of DDT might have migrated beyond the confines of the reservoir?

Action: Collect up to two (2) samples of recently deposited sediment from just below the dam that would represent sediment that was released during the drawdown.

2.0 SAMPLING AND ANALYSIS OBJECTIVES

- To characterize sediments in accordance with the regional dredge material testing manual, the Dredge Material Evaluation Framework for the Lower Columbia River Management Area (DMEF).
- Collect, handle and analyze representative sediments, as outlined above, in accordance with protocols and Quality Assurance/Quality Control (QA/QC) requirements.
- Determine level of risk to environment.
- Conduct physical and chemical characterization only, for this sediment evaluation.

3.0 SAMPLING AND ANALYSIS REQUIREMENT PROCEDURES

3.1 Project DQOs (Data Quality Objectives).

Analyses of the sediment at Cougar from the first round of sampling indicated Total DDT to be at levels ranging from 5.32 ppb to 32.63 ppb. The first round of sampling targeted fine-grain sediment and organic material to determine if contaminates of concern were present. This second round of sampling will attempt to determine, if these levels of DDT represent the total volume of material eroded and what environmental risk the levels of DDT present.

Table 1

Investigation Objectives	Data Requirements	Investigation Strategy	Field Decision Criteria/ Performance Specifications
Target Locations			
What were historical uses of surrounding areas? (Source of DDT.)	NA	Check sources from ODEQ, USFWS, ODFW, USFS, EPA, USGS, EWEB, OSU & previous Corps data for historical data on sediment sample collection and analyses.	NA
What historical sediment data may exist to help determine levels of DDT that existed upstream and downstream of the project prior to drawdown?	Data must have been analyzed using proper quality control with sufficiently low detection levels.	Check sources on the e-web, Forest Service, USGS, Eugene Water Dept. for historical data on sediment sample collection and analyses.	Collect samples above the Cougar pool on the South Fork of the McKenzie River.
Determine the background levels of DDT that exist above and below the project.	Samples must be collected, handled and analyzed for DDT using proper QA/QC with sufficiently low detection levels.	Find areas where fine-grained sediment has collected over time in back eddies.	Collect samples above the Cougar pool on the South Fork of the McKenzie River.
Determine the level of DDT that would represent all of the material	Samples must be collected, handled and analyzed for DDT using proper	1. Sample a vertical profile of previously sampled cut banks that	Determine boat availability for use in the Cougar pool. Locate confluence

Investigation Objectives	Data Requirements	Investigation Strategy	Field Decision Criteria/ Performance Specifications
eroded in the drawdown. (What is the level of DDT in the re-deposited sediment in the pool?)	QA/QC with sufficiently low detection levels.	represent all the material eroded and not just targeted fine-grained and organic material. 2. Surface sediment of each delta will be homogenous and represent the material eroded during drawdown.	areas from all major inlets to reservoir. Collect surface sediment from boat from within the present pool (1400') from the newly formed delta areas formed from eroded sediments.
Determine the potential for migration of DDT from the reservoir.	Samples must be collected, handled and analyzed for DDT using proper QA/QC with sufficiently low detection levels.	DDT Levels measured from recent sediment deposits down	Collect newly deposited sediment in the area immediately downstream of the dam.
If there has been migration, does it represent an added risk to the environment? What is an acceptable level risk?	Samples must be collected, handled and analyzed for DDT using proper QA/QC with sufficiently low detection levels.	The DMEF has adopted 6.9 ug/kg (ppb) as an AET* level for benthic organisms, with 50 ppb as the bioaccumulation trigger* for DDT. For this study, those levels are being considered protective.	Collect newly deposited sediment in the area immediately downstream of the dam.
Is the DDT bioavailable?	Benthic bioassay and bioaccumulation testing best answer bioavailability of DDT. Studies conducted in the PSSDA program have established chemical screening levels (6.9 ppb & 50 ppb) that have been adopted in the DMEF, and are being applied to this data set. If this screening level is exceeded biological testing will be recommended.	DDT, including DDE & DDD, is hydrophobic and binds tightly to the sediment. If absorbed into the water column DDT will quickly reattach to the sediment or volatilize into water and hydrochloric acid.	Benthic bioassay and bioaccumulation testing best answer bioavailability of DDT. Studies conducted in the PSSDA program have established chemical a screening level of 6.9 ppb for bioassay analyses and have been adopted in the DMEF, and are being applied to this data set. If this screening level is exceeded biological testing will be recommended. (It is recommended that 6.9 ppb be considered the trigger for bioaccumulation rather than 50ppb.)
Do the DDT levels reported in the first round of sampling represent the levels in the material eroded?	Analyze (at low detection levels) sediment to be collected in second round for Total DDT, include physical analyses and TOC.	Target entire prism of material that was eroded (or has potential to be eroded).	Re-sample areas where first round samples were collected and collect vertical profile of entire cut banks (not just target fine grain and organic materials).

Apparent Effects Threshold (AET) – were derived using a statistically based method that attempts to relate individual sediment contaminant concentrations with observed biological effects.
** Bioaccumulation Trigger – The level at which bioaccumulation testing for benthic organisms is required to establish suitability for in-water placement of sediment. The level at which statistical evidence of bioaccumulation in benthic organisms is present.
DMEF – Dredge Material Evaluation Framework
PSSDA – Puget Sound Dredged Disposal Analysis

4.0 SAMPLE COLLECTION AND HANDLING PROCEDURES

4.1 Sampling Locations and Numbering: Figure 1 shows the project and general sample location areas. Sampling sites are located for the best characterization of the material being eroded as possible. Proper QA/QC procedures as outlined in this section will be followed. Any deviation from these procedures shall be noted in the field log. Sample identification shall follow the following convention:

COUR-X-YY

Where, "COUR" denotes samples collected from the Cougar Reservoir, "X" denotes the type of sampling such as "G" = grab; "YY" denotes the numeric sample sequence number and will consist of two digits for all samples, except composites (i.e. 01, 05, 15, etc.). The QC replicates will have a letter designation in place of the numeric designation of the primary sample; e.g. "A" added (CS-GC-A). Duplicate samples will be identified in the field notes.

4.2 Field Sampling Schedule: Sampling is planned for August 6-7, 2002.

4.3 Field Notes: Field notes will be maintained during sampling and compositing operations. Included in the field notes will be the following:

- Names of the person(s) collecting and logging in the samples.
- Weather conditions.
- Depth of each station sampled as measured from the water surface. This will be accomplished using a leadline or corrected depth recorder.
- Date and time of collection of each sediment sample.
- The sample station number and individual designation numbers assigned for each individual sample.
- Descriptions of sediment or core sections.
- For simulated cores, the length of the vertical collection site will be measured and described.
- Any deviation from the approved sampling plan.

4.4 Positioning: Sampling locations will be recorded in the field. Horizontal coordinates will be referenced to the Oregon Coordinate System for proper North or South Zones NAD 83 (North American Datum 1983). Horizontal coordinates will be identified as latitude and longitude to the nearest 0.1 second.

4.5 Decontamination: All sampling devices and utensils will be thoroughly cleaned prior to use according to the following procedure:

- Wash with brush and Alconox soap
- Rinse with distilled water
- Rinse with 10% HCl solution
- Rinse with distilled water

Utensils used to collect physical samples only will not require the cleaning procedure listed. All utensils used to collect chemical samples will require decontamination prior to each use. All handwork for chemical analyses will be conducted with disposable latex gloves, which will be rinsed with distilled water before and after handling each individual sample, as appropriate, to prevent sample contamination. Gloves will be disposed of between samples or composites to prevent cross contamination between samples.

4.6 Core Logging: Each discrete core (simulated core) section will be inspected and described. For each core sample, the following data will be recorded on the core log as they apply:

- Sample recovery
- Physical soil description (includes soil type, density/consistency of soil, color)
- Odor (e.g., hydrogen sulfide, petroleum products)
- Visual stratification and lenses
- Vegetation
- Debris
- Biological Activity (e.g., detritus, shells, tubes, bioturbation, live or dead organisms)
- Presence of oil sheen

- Any other distinguishing characteristics or features

4.7 Field Compositing: Composite samples will be collected as described in section 1.3 above and restated here.
Action: Collect up to five (5) surface sediment samples for analyses, from sediment that has recently been eroded and homogenized during the drawdown even, from all the newly formed delta areas in the current reservoir (1400-foot elevation). Each sample submitted for analysis will consist of three (3) composite surface grab samples, using a ponar sampling devise.

4.8 Field Replicates: One (1) to two (2) project samples will be subjected to a three way split, with two portions submitted to the project lab (one with a blind duplicate ID) and the third portion submitted to a second laboratory as a quality assurance (QA) sample.

4.9 Sample Transport and Chain-of-Custody Procedures: After sample containers have been filled, they will be packed in ice or “blue ice” in coolers. Chain-of-custody procedures will commence in the field and will track delivery of the samples. Sample holding times and storage requirements are presented in Table 1. Specific procedures are as follows:

- Samples will be packaged and shipped in accordance with U.S. Department of Transportation regulations as specified in 49 CFR 173.6 and 49 CFR 173.24 or delivered directly to the testing laboratory.
- Individual sample containers will be packed to prevent breakage.
- The coolers will be clearly labeled with sufficient information (name of project, time and date container was sealed, person sealing the cooler and office name and address) to enable positive identification.
- Chain-of-custody forms will be enclosed in a plastic bag and placed inside cooler.

Upon transfer of sample possession to the laboratory, the persons transferring custody of the coolers will sign the chain-of-custody form. Upon receipt of samples at the laboratory, the coolers will be inspected and the receiver will record the condition of the samples.

Table 2, Sample Volume and Storage

Sample Type	**Holding Time**	**Sample Size (a)**	**Temperature (b)**	**Container**
Physical analysis	6 Months	200 g		1-1 Quart Plastic Bag
Total DDT	14 Days	125 g	4ºC	1-1 Liter Glass (combined)
Total Organic Carbon	14 Days	125 g	4ºC	

a. Required sample sizes for one laboratory analysis. Actual volumes to be collected have been increased to provide a margin of error and allow for retest.
b. During transport to the lab, samples will be stored on ice.

5.0 LABORATORY PHYSICAL AND CHEMICAL SEDIMENT ANALYSIS

5.1 Laboratory Analyses Protocols. Laboratory testing procedures will be conducted in accordance with the DMEF. The samples will be analyzed for all the parameters listed in sections 5.1.3 and 5.1.4

as requested on the chain-of-custody record. Private contract analytical chemical laboratories will conduct all physical and chemical analyses.

5.1.1 Chain-of-Custody: A chain-of-custody record for each set of samples will be maintained throughout all sampling activities and will accompany samples and shipment to the laboratory. Information tracked by the chain-of-custody records in the laboratory include sample identification number, date and time of sample receipt, analytical parameters required, location and conditions of storage, date and time of removal from and return to storage, signature of person removing and returning the sample, reason for removing from storage, and final disposition of the sample.

5.1.2 Limits of Detection: Detection limits of all chemicals of concern must be below screening levels. All reasonable means, including additional cleanup steps and method modifications, will be used to bring all limits-of-detection below the screening levels.

5.1.3 Sediment Chemistry: Private analytical laboratories will conduct all chemical analyses. Chemical analyses will include: Lead (Pb) by method 6020, Mercury (Hg) by method7470 or 7471), total organic carbon (TOC) by method 9060 and DDT by method 8081.

5.1.4 Sediment Conventionals: The private analytical laboratories will analyze physical parameters. Particle grain size distribution for each sample will be determined. Sieve analysis will use a geological sieve series, which will include the sieve sizes U.S. NO. 5, 10, 18, 35, 60, 120, and 230. Hydrogen peroxide will not be used in preparations for grain-size analysis. Hydrometer analysis will be used for particle sizes finer than the 230 mesh. Water content will be determined using ASTM D 2216. Sediment classification designation will be made in accordance with U.S. Soil Classification System, ASTM D 2487.

5.1.5 Holding Times: To the maximum extent practicable all chemical results will be provided within 7-14 days of receipt. All samples for physical and chemical testing will be maintained at the testing laboratory at the temperatures specified in Table 1 and analyzed within the holding times shown in the table.

5.1.6 Quality Assurance/Quality Control: The chemistry QA/QC procedures found in Table 2 will be followed.

5.2 Laboratory Written Report: The analytical laboratory documenting all the activities associated with sample analyses will prepare a written report. As a minimum, the following will be included in the report:

- Results of the laboratory analyses and QA/QC results.
- All protocols used during analyses.
- Chain of custody procedures, including explanation of any deviation from those identified herein.
- Any protocol deviations from the approved sampling plan.
- Location and availability of data.

As appropriate, this sampling plan may be referenced in describing protocols.

Table 3, Minimum Laboratory QA/QC

Analytical Type	Method Blank[2]	Duplicate[2]	RM[2, 4]	Matrix Spikes[2]	Surrogates[7]
DDT	X	X[3]	X[5]	X	X
Total Organic Carbon	X	X	X[6]		
Total Solids		X			
Total Volatile Solids		X			
Particle Size		X			

1. Initial calibration required before any samples are analyzed, after each major disruption of equipment, and when ongoing calibration fails to meet criteria. Ongoing calibration required at the beginning of each work shift, every 10-12 samples or every 12 hours (whichever is more frequent), and at the end of each shift.
2. Frequency of Analysis = one per batch
3. Matrix spike duplicate will be run
4. Reference Material
5. Canadian standard SRM-1
6. NIST certified reference material 2704
7. Surrogate spikes will be included with every sample, including matrix-spiked samples, blanks and reference materials.

6.0 BIOLOGICAL TESTING

6.1 Bioassays are not planned for this sampling event. If total DDT levels exceed 6.9 ug/kg, bioassay and bioaccumulation analyses will be recommended.

7.0 REPORTING

<u>7.1 QA Report:</u> The laboratory QA/QC reports will be incorporated by reference. This report will identify any laboratory activities that deviated from the approved protocols and will make a statement regarding the overall validity of the data collected.

<u>7.2 Sediment Evaluation Report:</u> A written discussion of findings shall be prepared documenting the physical and chemical character of potential material to be dredged. The physical and chemical reports will be included as reference; individual copies will be furnished as requested. As a minimum, the following will be included in the

- Previous sampling and analyses.
- Locations where the sediment samples were collected.
- A plan view of the project showing the actual sampling location.
- Description of sampling.
- Chemical testing data, with comparisons to screening level guidelines.
- Biological testing data and evaluation based on the DMEF manual.

8.0 REFERENCES

1. U.S. army Corps of Engineers, Portland District, Seattle District; U.S. Environmental Protection Agency, Region 10; Oregon Department of Environmental Quality; Washington State Department of Natural Resources and Department of Ecology. 1998 Final. Dredge Material Evaluation Framework for the Lower Columbia River Management Area.

2. U. S. Environmental Protection Agency and U. S. Army Corps of Engineers. February 1998. Evaluation of Dredged Material Proposed for Discharge in Inland and Near Coastal Waters – Testing Manual, dated (referred to as the "Inland Testing Manual").

3. The Clean Water Act, 40 CFR 230 (b) (1).

4. U.S. army Corps of Engineers, Portland District. Cougar Lake, Willamette Temperature Control Intake Structure modifications, Design Memorandum No. 21, 31 July 1998.

5. Sittig, Marshall. 1981. Handbook of Toxic and Hazardous Chemicals. Noyes Publication, New Jersey.

6. Merck & Co. 1976. The Merck Index an Encyclopedia of Chemicals and Drugs. Rahway, New Jersey.

7. Spectrum Laboratories: Chemical fact sheet – Cas # 6216647). http://www.speclab.com/compound/c621647.htm

PARAMETERS AND METHODS

1. Recommended Sample Preparation Methods, Cleanup Methods, Analytical Methods and Detection Limits for Sediment Management Standards, Chapter 173-204 WAC, Draft - July 1996.

2. Recommended Protocols for Measuring Conventional Sediment Variables in Puget Sound, Puget Sound Estuary Program, March 1986.

3. Recommended Methods for Measuring TOC in Sediments, Kathryn Bragdon-Cook, Clarification Paper, Puget Sound Dredged Disposal Analysis Annual Review, May 1993.

4. Units: ug = microgram, mg = milligram, kg = kilogram, DW = dry weight, oc = organic carbon.

5. Test Methods for Evaluating Solid Waste. Laboratory manual physical/chemical methods. Method 3050, SW-846, 3rd ed., Vol. 1A, Chapter 3, Sec 3.2, Rev 1. Office of Solid Waste and Emergency Response, Washington, DC.

6. Graphite Furnace Atomic Absorption (GFAA) Spectrometry - SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.

7. Inductively Coupled Plasma (ICP) Emission Spectrometry - SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.

8. Test Methods for Evaluating Solid Waste. Laboratory manual physical/chemical methods. Method 7471, SW-846, 3rd ed., Vol. 1A, Chapter 3, Sec 3.3. Office of Solid Waste and Emergency Response, Washington, DC.

9. Sonication Extraction of Sample Solids - Method 3550 (Modified), SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986. Method is modified to add matrix spikes before the dehydration step rather than after the dehydration step.

10. GCMS Capillary Column - Method 8270, SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.

11. Purge and Trap Extraction and GCMS Analysis - Method 8260, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.

12. Soxhlet Extraction and Method 8081, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.

13. Total PCBs BT value in mg/kg oc.

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QA2 DATA REQUIREMENTS

CHEMICAL VARIABLES

ORGANIC COMPOUNDS

The following documentation is needed for organic compounds:

A cover letter referencing or describing the procedure used and discussing any analytical problems.

Reconstructed ion chromatograms for GC/MS analyses for each sample.

Mass spectra of detected target compounds (GC/MS) for each sample and associated library spectra.

GC/ECD and/or GC/flame ionization detection chromatograms for each sample.

Raw data quantification reports for each sample.

A calibration data summary reporting calibration range used [and decafluorotriphenylphosphine (DFTPP) and bromofluorobenzene (BFB) spectra and quantification report for GC/MS analyses].

Final dilution volumes, sample size, wet-to-dry ratios, and instrument detection limit.

Analyte concentrations with reporting units identified (to two significant figures unless otherwise justified).

Quantification of all analytes in method blanks (ng/sample).

Method blanks associated with each sample.

Recovery assessments and a replicate sample summary (laboratories should report all surrogate spike recovery data for each sample; a statement of the range of recoveries should be included in reports using these data).

Appendix C

Operational Alternatives - Technical Summary

APPENDIX C

OPERATIONAL ALTERNATIVES - TECHNICAL SUMMARY

Background. A revised operational plan is being developed for the Cougar Lake Project, Willamette River Temperature Control as part of a Supplemental Information Report (SIR) which will address high turbidity levels in the South Fork McKenzie River below the project associated with the Spring 2002 drawdown of Cougar reservoir. The revised plan will cover the entire construction sequence for this project.

Spring 2002 Drawdown. Reservoir drawdown at Cougar began at a rate of 3 feet per day. A major April rainstorm delayed completion of drawdown. The process was halted on May 26, 2002, at elevation 1,400 feet instead of the projected 1,375 feet due to unexpected high levels of turbidity. Figure 1 shows the pool elevation, releases and turbidity measured immediately downstream of the project.

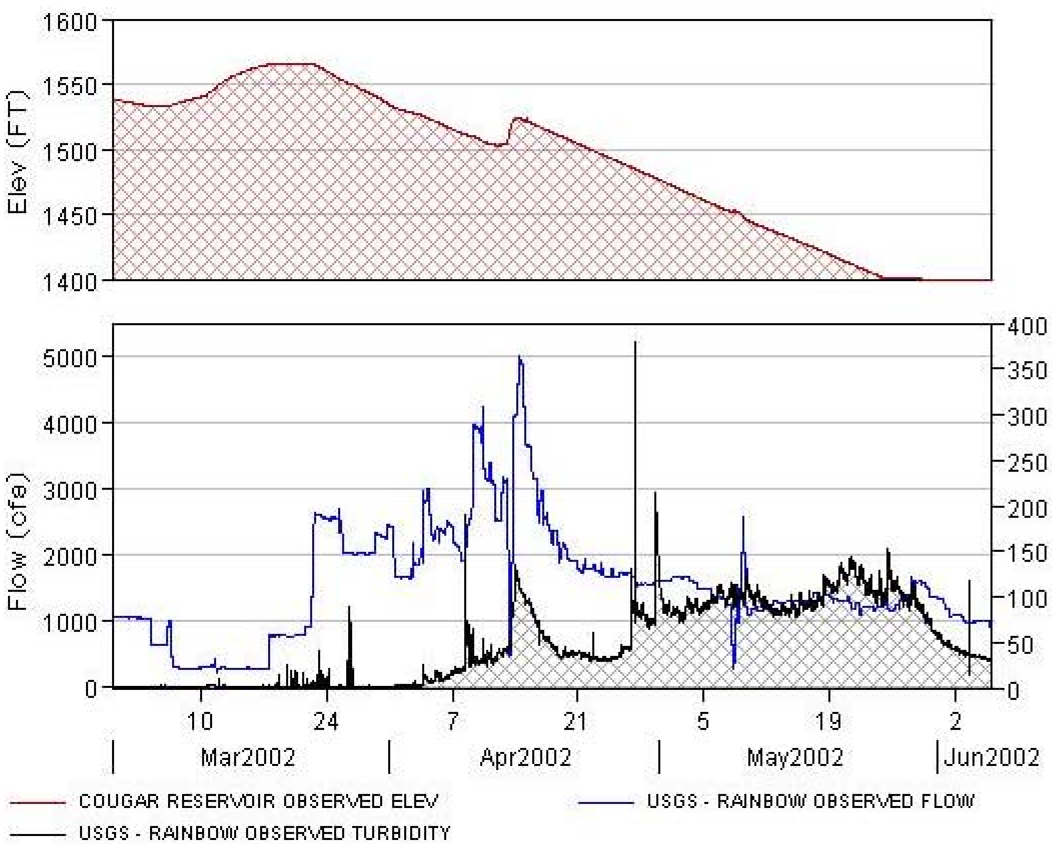

Figure 1 - Measured turbidity downstream of Cougar Dam vs. pool elevation and releases - 3/01 - 7/6/02

Proposed Revised Operating Plans. The proposed actions available for reducing the high spring turbidity associated with drawdown were increasing the drawdown rate below pool elevation 1532 ft, adjusting the winter flood control pool, and target date to reach the residual or construction pool of 1400 ft. These proposed actions were combined into six alternative operational plans. A target date of March 1st for drawdown to 1400 is desired, as it gives a month to flush out any residual turbidity in the lower pool prior to the start of construction on April 1. Table 1 summarizes the alternative plans studied.

Table 1 - Cougar SIR Operational Alternative plans

Alternative	Target date	Drawdown rate	Winter Pool Elev.
LP1	-	3 ft/day	1400 ft
LP2	-	6 ft/day	1400 ft
HP1	March 1	3 ft/day	1532 ft
HP2	April 1	3 ft/day	1532 ft
HP3	March 1	6 ft/day	1532 ft
HP4	April 1	6 ft/day	1532 ft

Advantages and disadvantages for maintaining the pool this winter at or near elevation 1,400 feet are listed below.

Advantages:

- Widening and armoring of existing channel feeding lower reservoir pool due to winter flows, reduced risk of old channel abandonment/new channel formation.
- Higher probability of reaching elevation 1,400 by March 1 if there is a high-water event during the winter. This is because of the lower residual pool elevation prior to the high-water event (i.e., there is a higher probability of having a lower pool elevation after storing a flood).
- During the winter, a shorter timeframe for flushing turbid water from the residual pool because of the lower volume and detention time.
- Vegetation established below 1,532 feet during summer 2002 would not be drowned out, and become better established. This would reduce erosion in the lower pool, thereby reducing sources of turbidity within the reservoir. Turbidity in succeeding years would be reduced as a result.

Disadvantages:

- Higher turbidity during the winter. Increased number of turbidity events and increased turbidity associated with each event. Rapid rises in the pool level during winter storms will result in erosion of exposed sediments surrounding the residual pool.
- Higher and more variable flows downstream of the reservoir during the winter.

Advantages and disadvantages for filling the reservoir to elevation 1,532, then drawing it back down again in mid-January are listed below.

Advantages:

- Reduced probability of turbid flows below the dam during the winter if the reservoir fills with clear water, or following clearing of turbidity from the reservoir after it fills.
- Reduced or more normal winter turbidity downstream of Cougar reservoir during the filling period.

Disadvantages:

- Increase in risk that a new channel could be formed during the next drawdown to 1,400 ft. The new channel would cut through erodable material in the mid pool area transporting more material to the lower reservoir pool, increasing turbidity of the pool overall.
- Higher risk of increased turbidity below the dam during the spring as sediment re-distributed and deposited in the reservoir channel during inundation is re-suspended during drawdown.
- Lower probability of reaching el. 1,400 by March 1 if there is a mid-January or mid-February high-water event. A high-water event in mid-January or mid-February would impact the timing and duration of drawdown increasing the chance of turbid flows in the spring.
- Longer timeframe for flushing turbid water from the reservoir over winter because of the larger volume and longer detention time. However, turbidity would not peak as high.

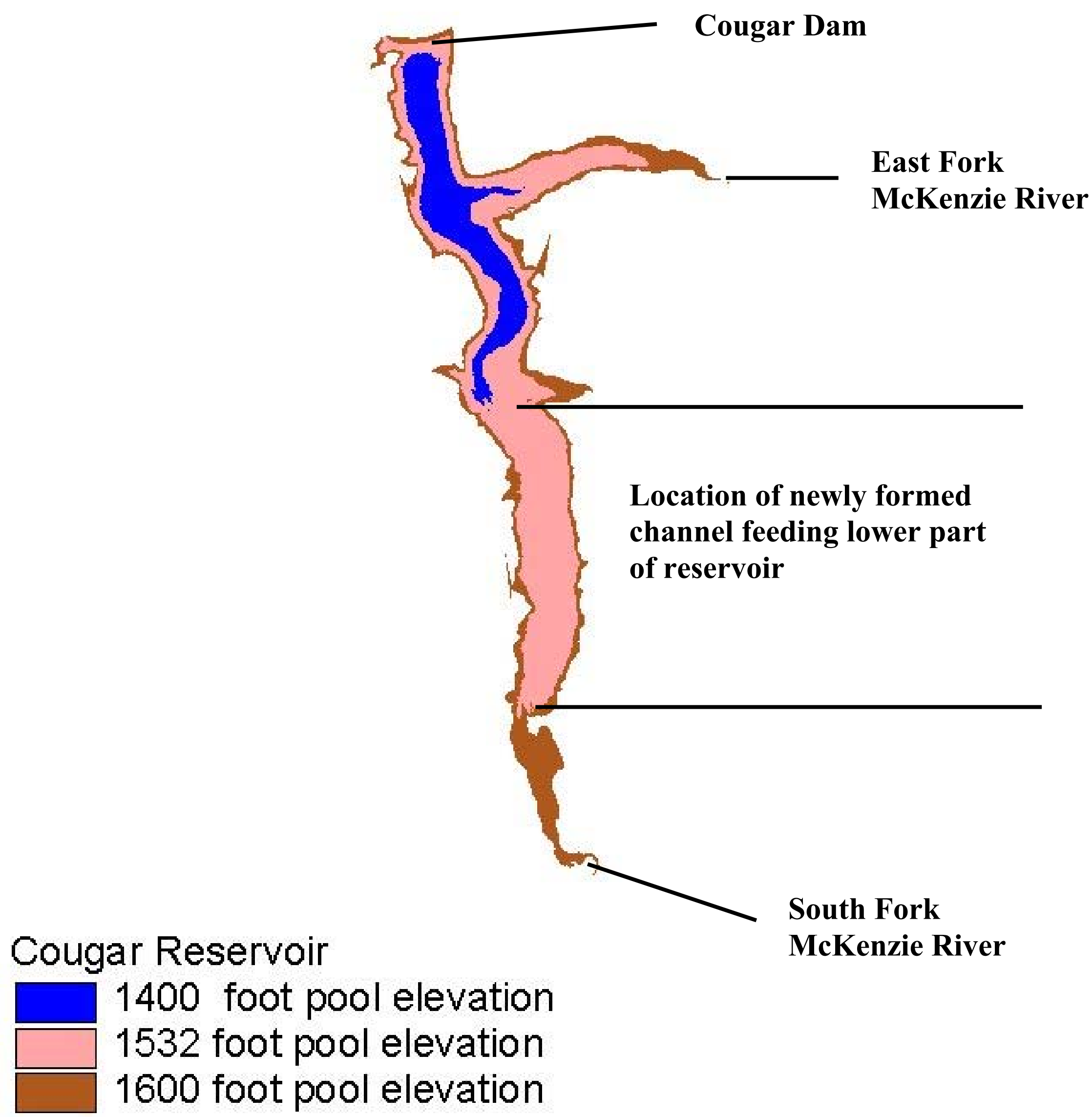

Figure 2 - Map of Cougar Reservoir showing approximate extent of 1400 and 1532 ft pool levels and location of tributaries feeding the reservoir.

Modeling of Proposed Alternative Plans In order to assess the potential effects of the six proposed operational plans on the McKenzie River system and Blue River Reservoir, system analysis was performed using HEC ResSim, a computer model specifically designed for reservoir operational analysis,

The McKenzie River system was modeled to Vida, OR, the control point on the lower McKenzie (Figure 3). Blue River and Cougar reservoirs were operated for flows immediately downstream (maximum flows 3700 and 6500 cfs respectively) and at Vida (maximum flow - 14,500 cfs). Minimum flows at Blue River and Cougar were 50 and 250 cfs respectively.

Figure 3 - Schematic diagram of McKenzie River system model

Outlet Capacity. Cougar reservoir is currently utilizing a diversion tunnel, in addition to the regulating outlets used during normal operation. All releases below pool elevation 1510 feet are made through the diversion tunnel.

The Regulating Outlets and Emergency Spillway release capacities were also defined in the model. Figure 4 shows rating curves for the diversion tunnel, and combined diversion tunnel and regulating outlets. The Regulating Outlets and Emergency Spillway rating curves for Blue River were used to develop the reservoir model for Blue River.

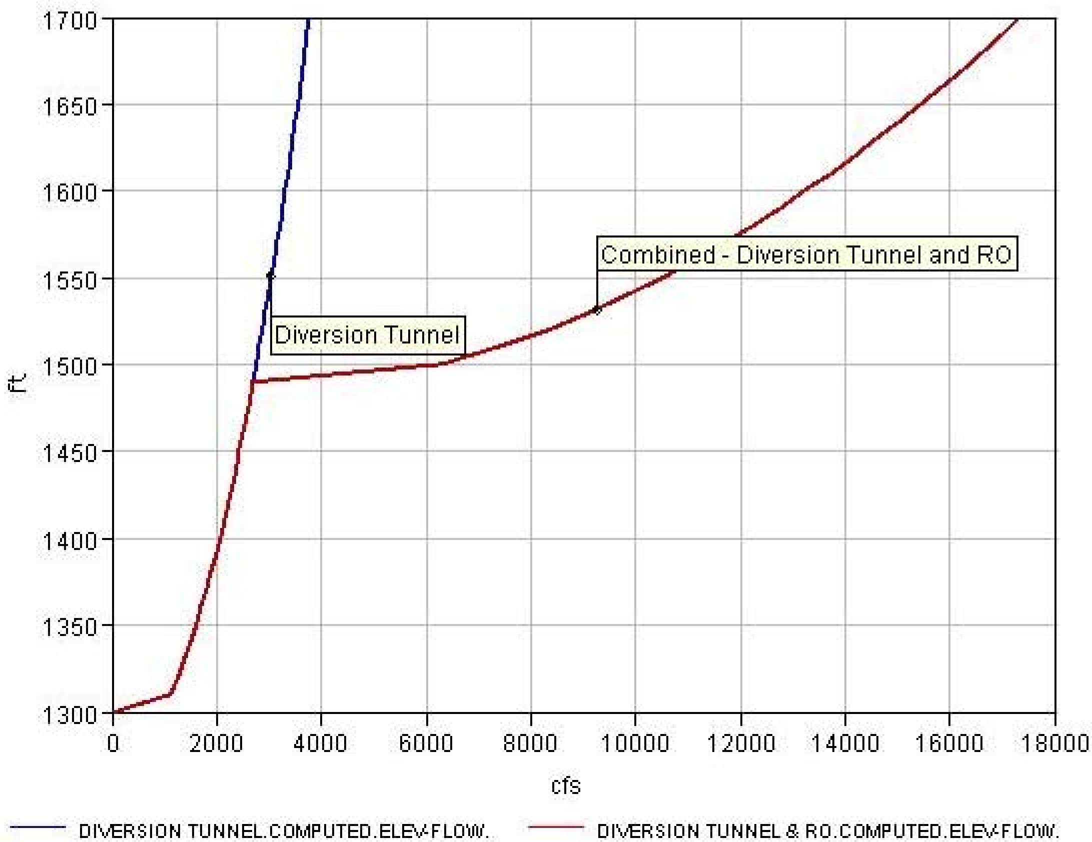

Figure 4 - Cougar Reservoir - Rating Curves for Diversion Tunnel, Combined Diversion Tunnel and Regulating Outlets.

Operational Alternatives The six operational alternatives for Cougar were modeled using guide curves to define the target pool elevations and target dates. Rules were used to define maximum and minimum flow targets downstream of the dam and at Vida, drawdown rates, and spillway releases. A simulation representing normal operation for Cougar (pre-WTC construction) and Blue River was run for comparison. Guide curves for normal operation for Cougar and Blue Rive are shown in Figure 5. The Blue River operation was defined using its normal operational guide curve. Rules were used to define maximum and minimum flow targets downstream of the dam and at Vida, and spillway releases. The guide curves used for the low and high pool alternatives are shown in Figure 6.

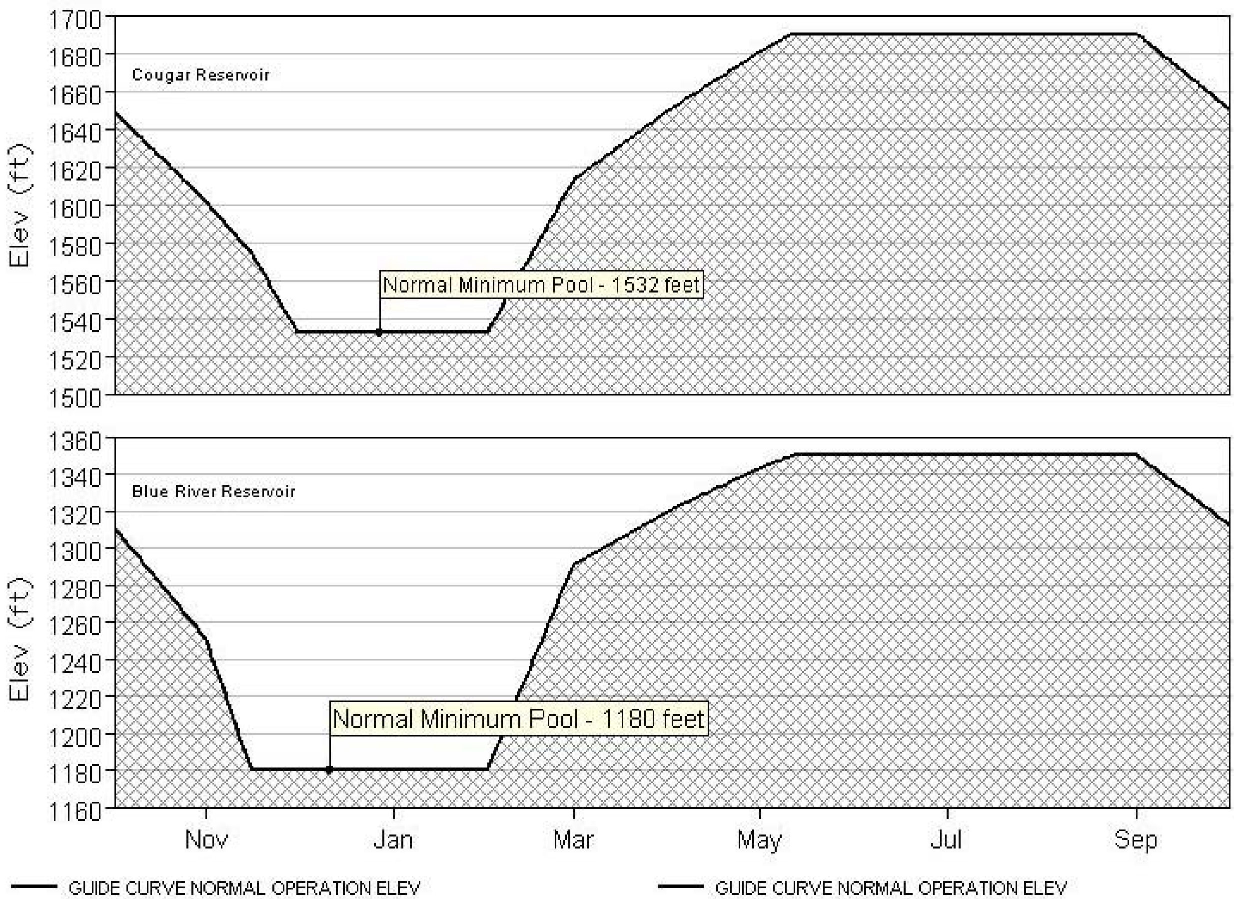

Figure 5 - Normal Operational Guide Curves for Blue River and Cougar (Pre-WTC construction)

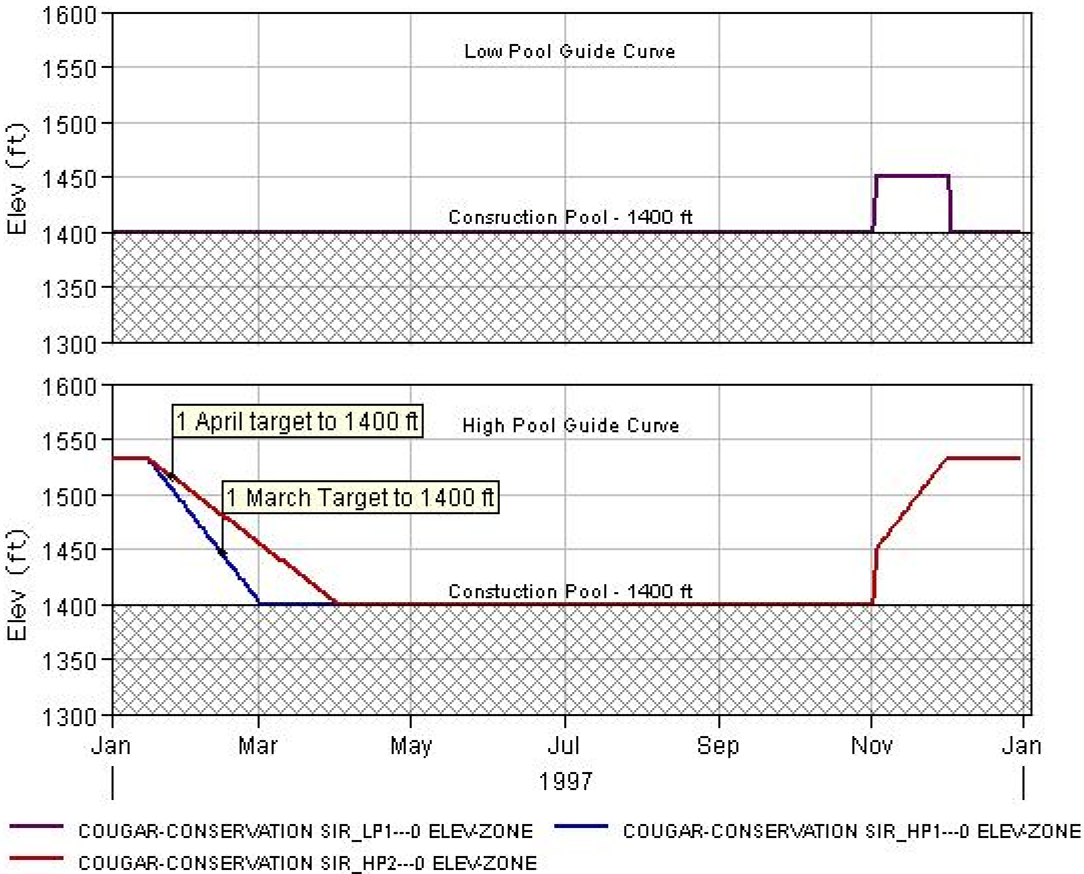

Figure 6 - Guide Curves for Cougar Reservoir, Low and High Pool alternatives

The high pool guide curve commences drawdown of the reservoir on January 15th, 16 days earlier than under normal operation. The start of drawdown is advanced in order to increase the probability that the reservoir pool will be at 1400 feet by the March 1st through April 1st time period.

Modeling of Alternatives. In order evaluate the effect of the alternatives on the McKenzie River System and determine the probability of having the pool at 1400 feet by March 1, a simulation using daily mean flows was run from 1935 through 1998. A simulation using hourly data was run from Oct 2001 through June 2002, to assess the performance of the alternatives on last year's operation. An additional simulation was run from November 1996 through March 1997 to assess the effects of holding the pool at 1400 feet in a high water year.

Results – 1935 through 1998 daily mean flows Results of the modeling showed that the alternatives with the best chance of meeting the March 1st target date were HP3 and LP2. Both alternatives incorporate the 6-ft/day drawdown option. Figures 7 and 8 show the 90 percent non-exceedance plot of the high and low pool alternatives. Tables 2 and 3 show 10 through 90 percent non-exceedance values at March 1st and April 1st.

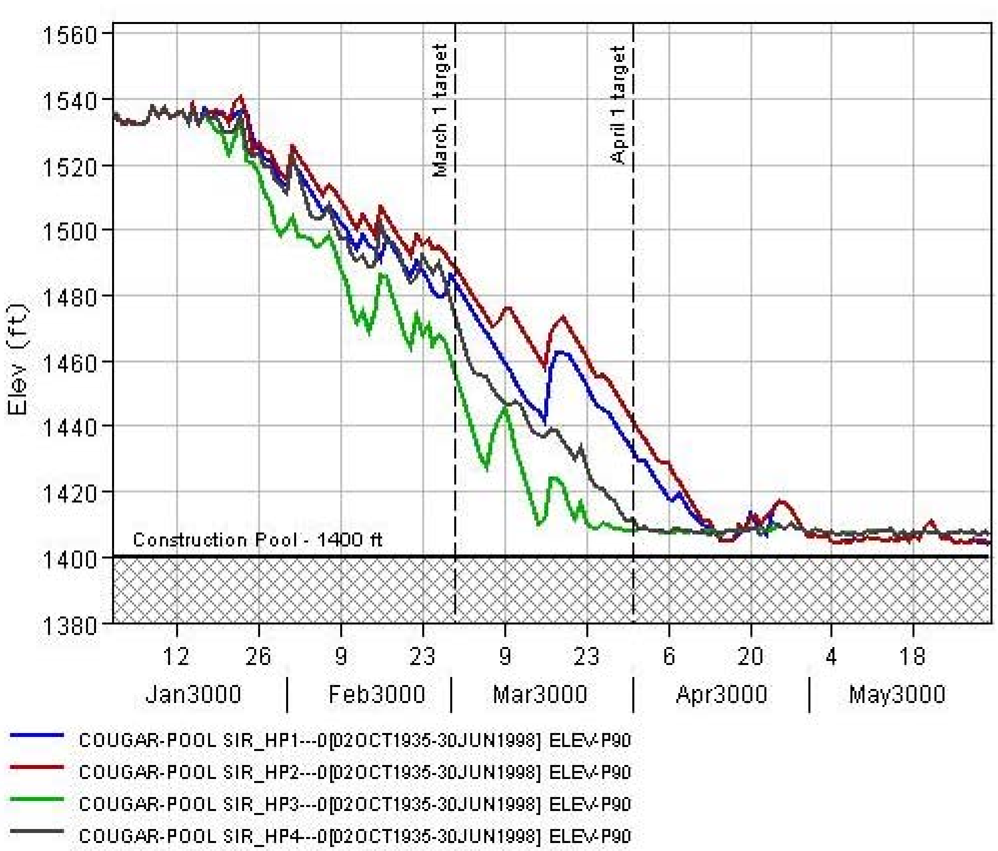

Figure 7 - Cougar Reservoir High Pool operational alternatives, 1 March target date - 90% non exceedance pool elevations (January to May)

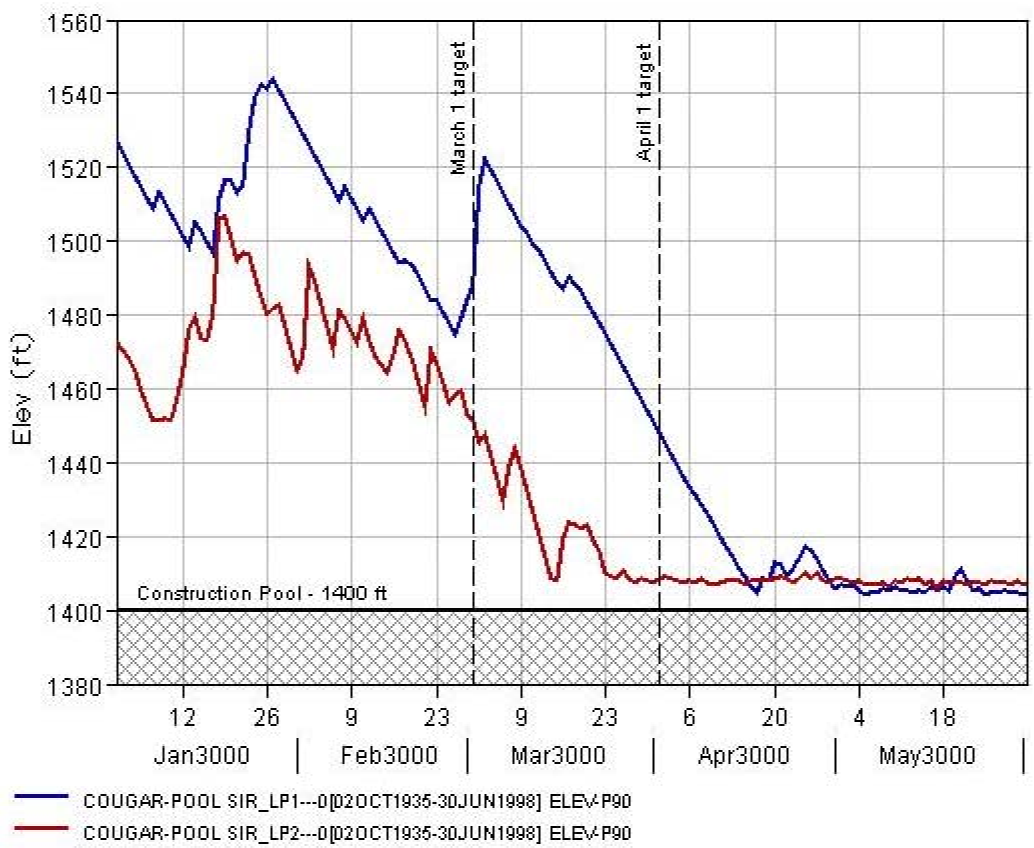

Figure 8 - Cougar Reservoir Low Pool operational alternatives - 90% non exceedance pool elevations (January to May)

Table 2 – Cougar Pool Elevations (in feet) , 10 - 90 % non-exceedance probabilities at March 1st

Alternative	10 %	25%	50%	75%	90%
HP1	1404	1405	1412	1443	1483
HP2	1454	1456	1457	1460	1488
HP3	1401	1403	1406	1412	1455
HP4	1454	1456	1459	1461	1472
LP1	1400	1401	1404	1435	1464
LP2	1396	1400	1403	1407	1447

Table 3 - Cougar Pool Elevations (in feet), 10 - 90 % non-exceedance probabilities at April 1st

Alternative	10 %	25%	50%	75%	90%
HP1	1399	1400	1402	1405	1429
HP2	1401	1402	1404	1405	1439
HP3	1396	1400	1402	1407	1409
HP4	1400	1401	1403	1407	1409
LP1	1399	1400	1403	1404	1422
LP2	1396	1399	1401	1406	1409

Recommended Alternative. If the reservoir pool were raised to elevation 1532 feet, it would only be maintained at that elevation for about 6 weeks. As such, most of the benefits of keeping the reservoir pool at elevation 1532 feet may not be realized. In addition, the difference between the two elevation alternatives is only significant for an average or below average water year. An above average water year does not significantly favor either alternative.

Given the number of advantages for maintaining the reservoir pool at or near elevation 1400 feet, the preferred operational alternative is to keep the pool at or near elevation 1400 feet for the next two flood control seasons using a drawdown rate of 6 ft/day below elevation 1532 feet (LP2).

March 2002 through June 2002 simulation under selected alternative A simulation was run with alternatives LP1 and LP2 to determine the pool levels and releases, which would have resulted during the late spring storm under the different rate of drawdown scenarios. Figure 9 shows a comparison of spring 2002 pool levels under LP1 and LP2.

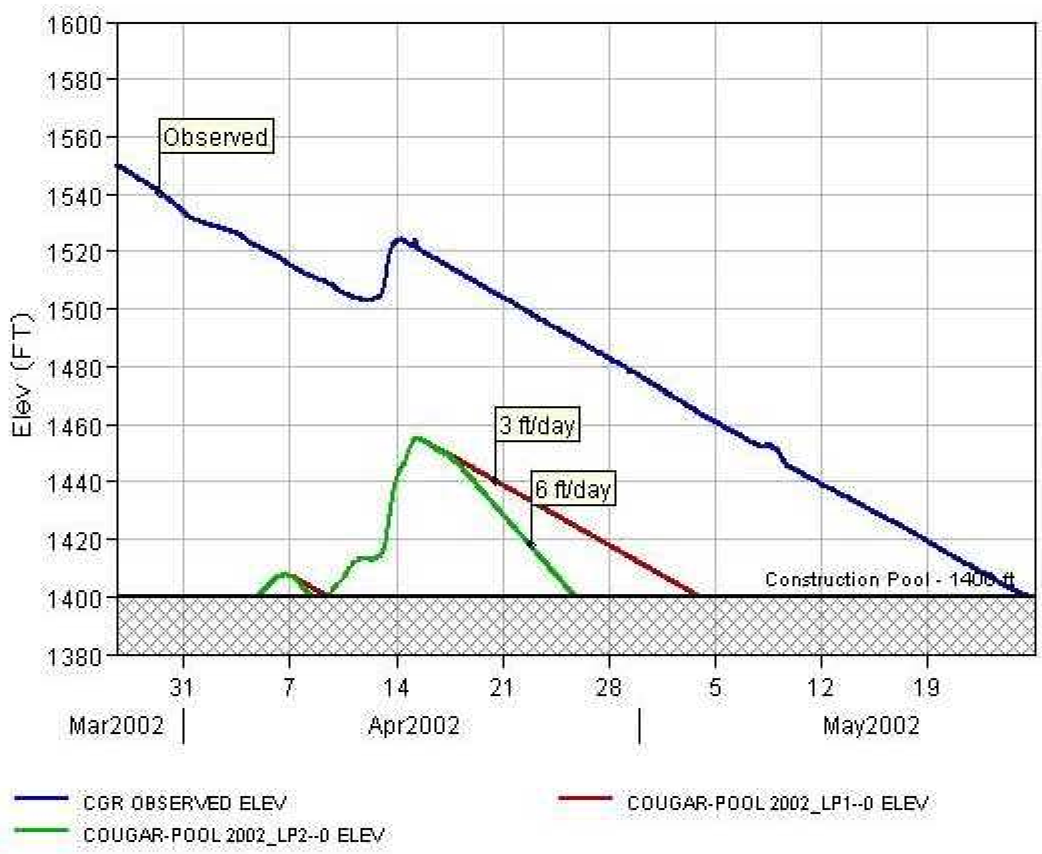

Figure 9- March - May 2002 Cougar Observed Pool Elevation vs LP1 and LP2

The late spring rain event would have raised the pool elevation to 1455 feet on April 16th. The pool would have been drawn down back to 1400 feet by April 26th under LP2 and May 3rd under LP1. It is probable that turbidity levels would have still been elevated during this period, however the duration of the elevated turbidity levels would have been reduced significantly from what occurred in last year when the pool reached 1400 feet on May 26th. Using a 6-ft/day drawdown rate decreased the duration of the drawdown by 8 days vs. using a 3ft/day drawdown rate.

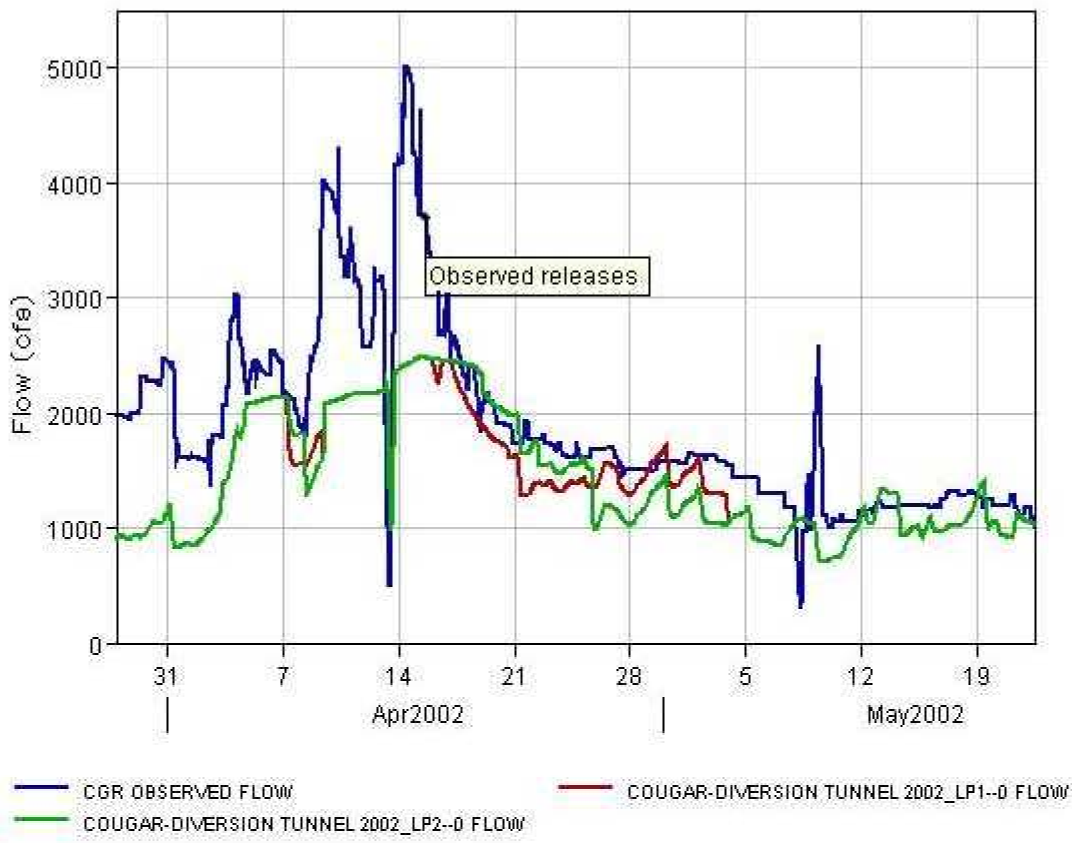

Figure 10 -Comparison of April – May 2002 Cougar releases with LP1 and LP2

Results – Winter 1996- 1997 flows A simulation was run from November 1996 through March 1997 to assess the effects of holding the pool at 1400 feet in a high water year. Under LP1, the maximum pool level reached was 1655 feet on Jan 4. On March 1, the pool was at 1457 feet and 1404 feet on April 1. Under LP2, the maximum pool reached was 1642 feet on Jan 4. On March and April 1 the pool was at 1400 feet. The results show that under LP2, the pool would be at 1400 feet at March and April 1 in a high water year. Figure 11 shows pool levels under LP1 and LP2, November 1996 through March 1997.

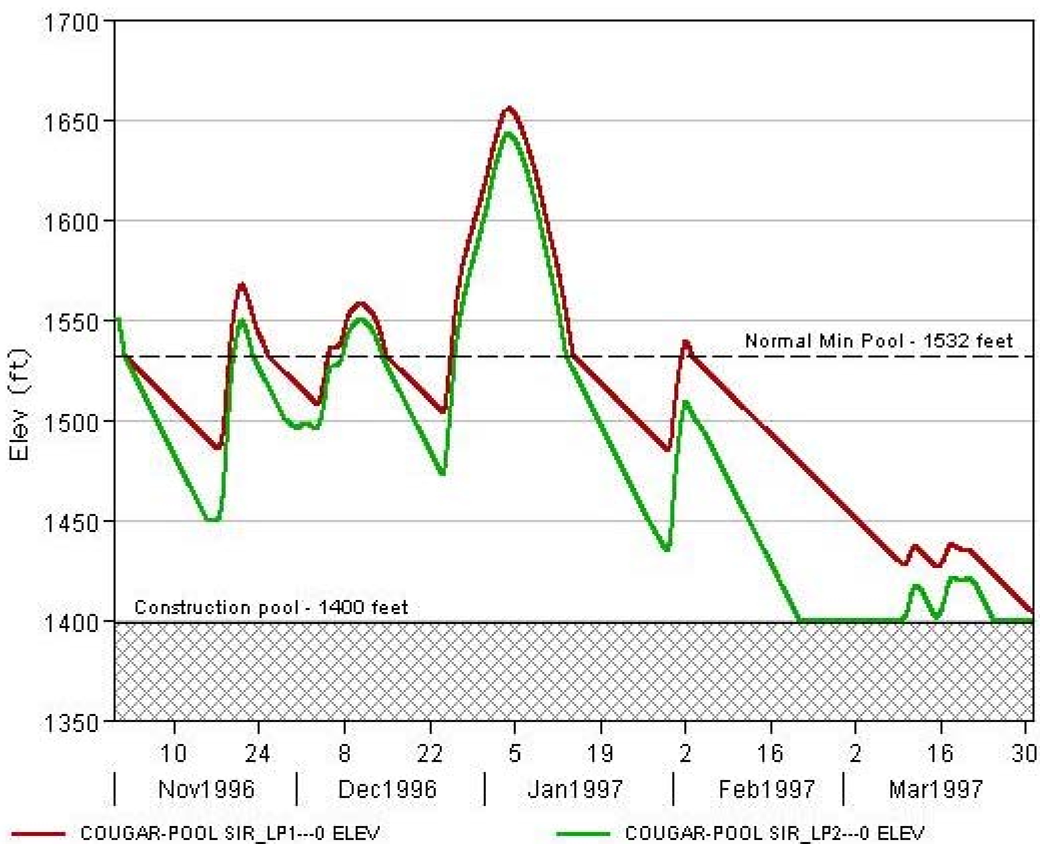

Figure 11 – Cougar Reservoir Pool levels, Winter 1996-1997 under LP1 and LP2.

Impact to flows at Vida, Oregon The 50 percent (median) non-exceedance plots comparing normal flows at Vida with the six alternatives show that the discharge in the main stem McKenzie at Vida will be higher in all cases. This is due to the elimination of summer or conservation storage pool that would normally be in place. Thus, water that would normally go into reservoir storage is contributing to mainstem McKenzie River flows. As expected, the alternatives with the higher drawdown rate will cause more variability in flow (Figures 12 – 14).

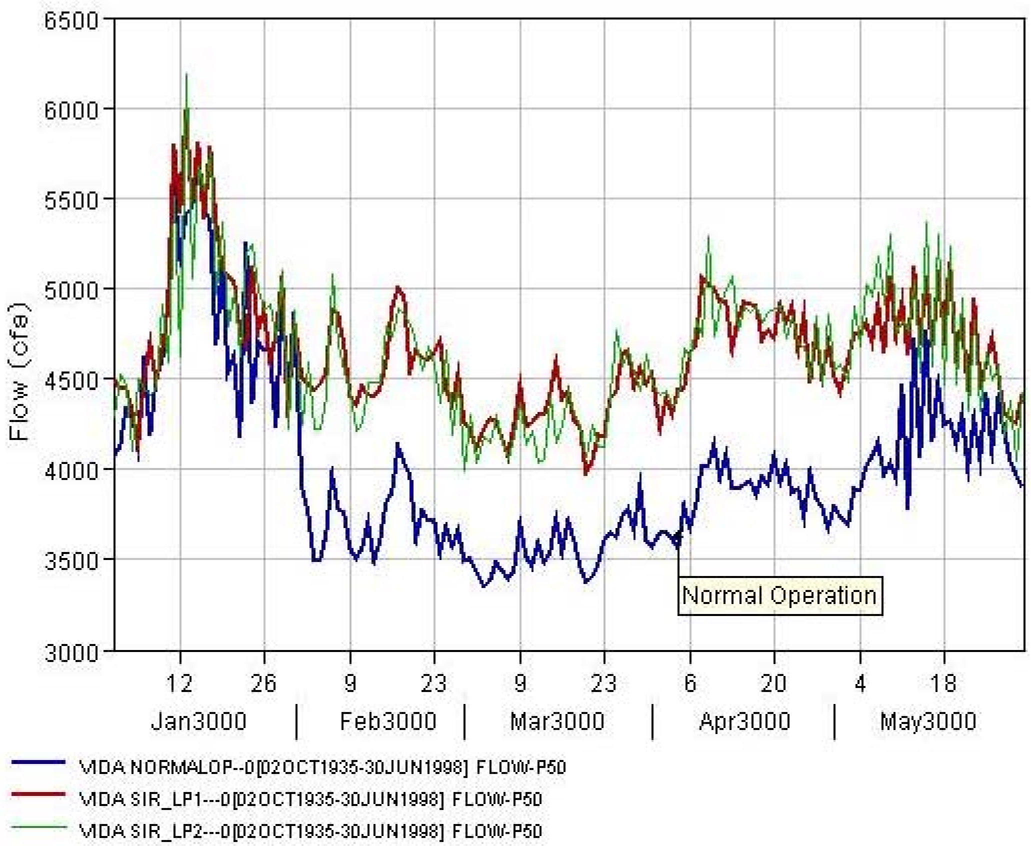

Figure 12 - Comparison of flows at Vida, OR. Normal Operation vs LP1 and LP2.

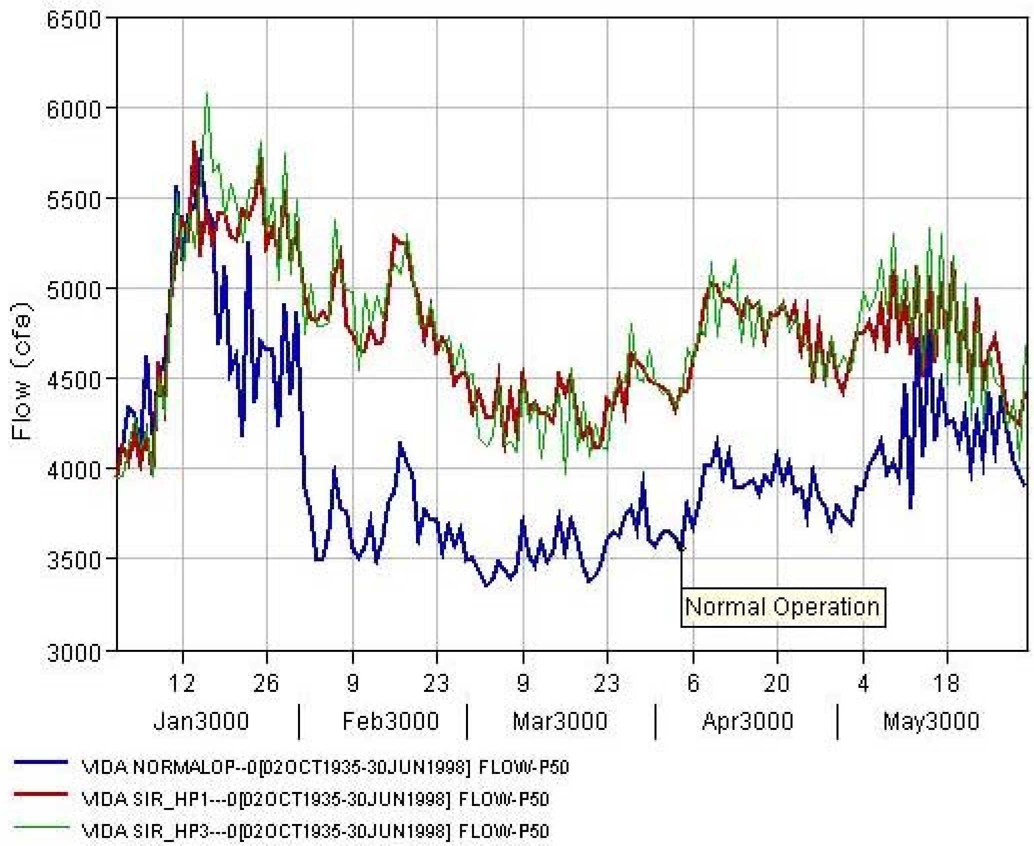

Figure 13 -Comparison of flows at Vida, OR. Normal Operation vs. HP1 and HP3.

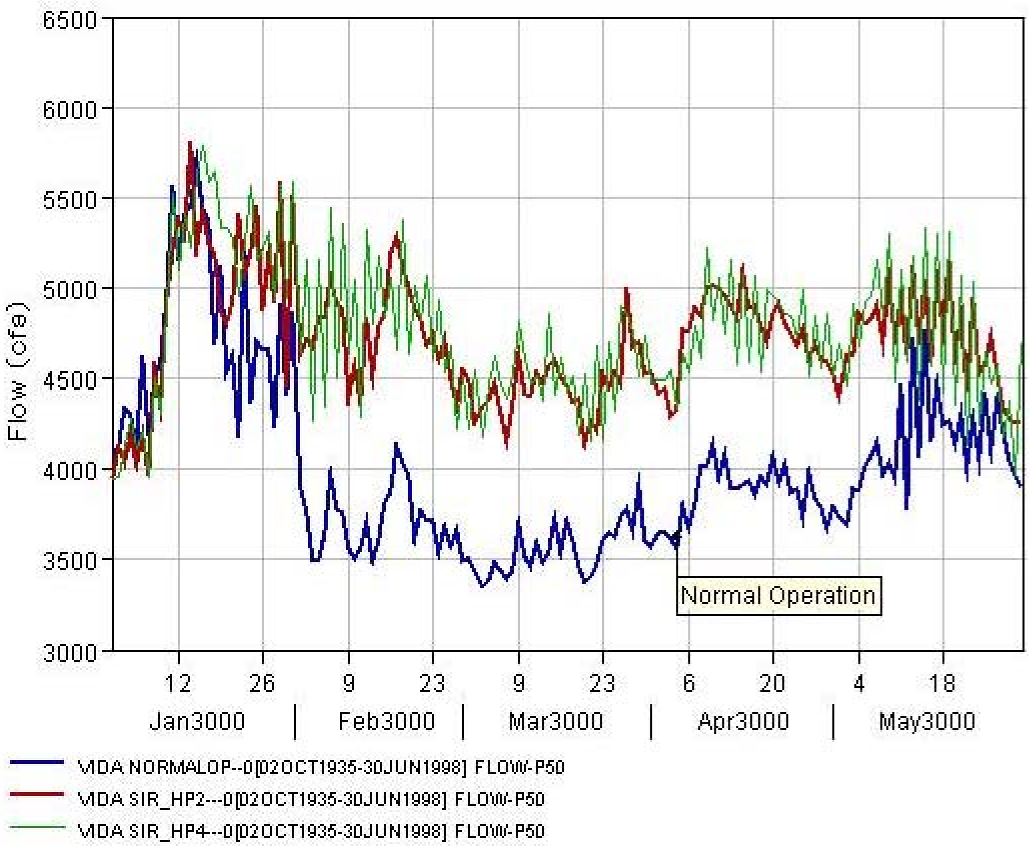

Figure 14 -Comparison of flows at Vida, OR. Normal Operation vs. HP2 and HP4.

Software Used - HEC ResSim, Version 1.02.0004

Appendix D

Sediment Concentration and Discharge Computations

APPENDIX D

SEDIMENT CONCENTRATION AND DISCHARGE COMPUTATIONS

Equations for Suspended Sediment Concentration (SSC) as a function of turbidity are developed using linear regression methods with SSC as the dependent variable and turbidity as the independent variable. The equations developed are site specific and are typically based on data collected over a wide range of streamflows and basin conditions. Many factors may influence the SSC–turbidity (SSC-T) relationship for any given site, such as the geology of the watershed, soils, vegetation, slope, aspect, and land use (Lewis, et al., 2002).

The SSC-T relationship is also affected by the effects of sediment loading over time as exhibited downstream of reservoirs. In general, sediment discharge from reservoirs tends to be higher in fine sediment, as the coarser fraction settles out in the reservoir pool.

To provide estimates of SSC in the South Fork McKenzie river below Cougar reservoir, the Corps used data from the USGS North Santiam River Basin Suspended-Sediment and Turbidity Study (Urich, et al, 2002). SSC-T relationships were developed for five sites in the North Santiam basin, and provided by the USGS. Three sites were located on tributary streams draining Detroit reservoir and two sites were located on the North Santiam below Detroit reservoir. Figure 1 shows the location of the sites.

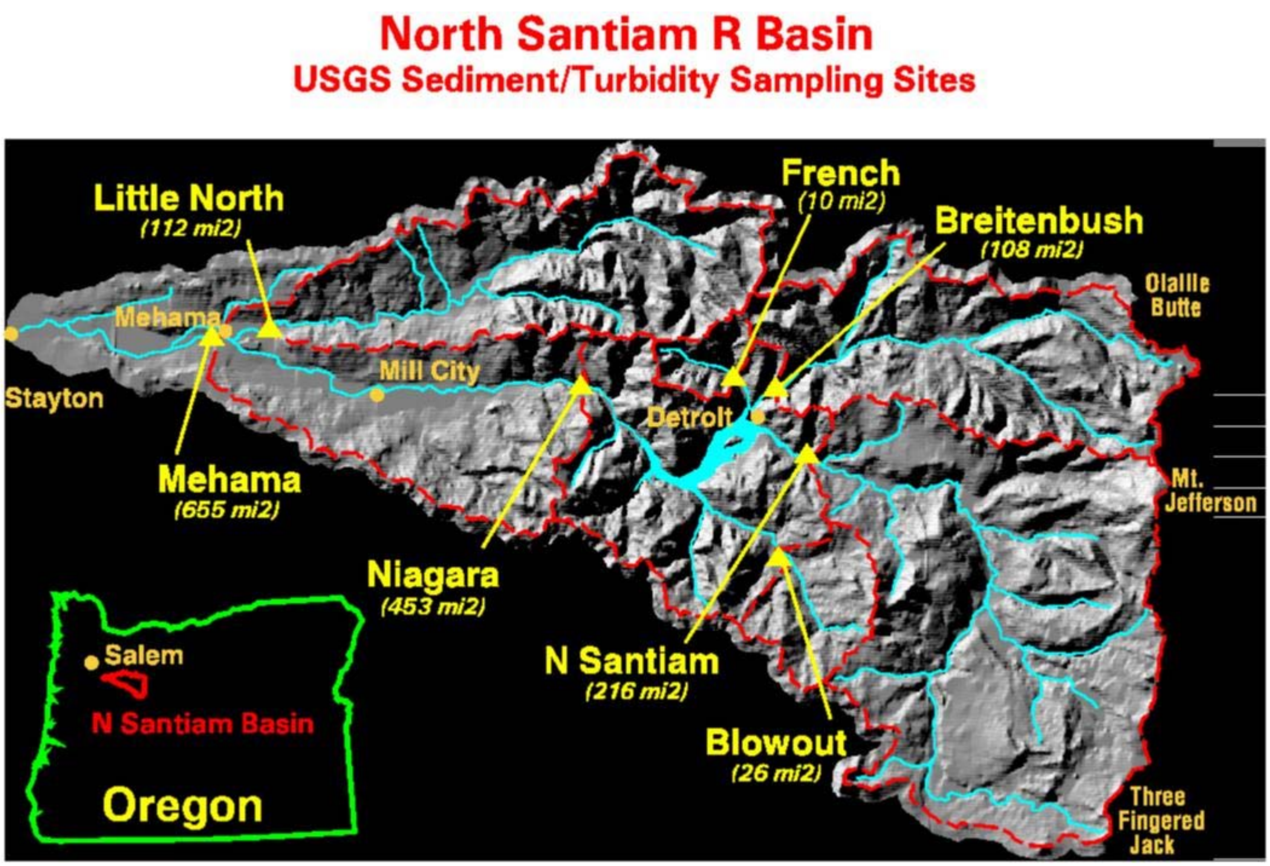

Figure 1- SSC-Turbidity data collection sites - North Santiam River Basin Suspended-Sediment and Turbidity Study. Image source - http://oregon.usgs.gov/projs_dir/or00311/

After evaluation of the five SSC-T relationships provided (Table 1), the Corps used the SSC-Turbidity relationship at Mehama, OR (USGS gage 14183000) to develop its SSC and sediment discharge estimates for the South Fork McKenzie river below Cougar reservoir.

Table 1 - North Santiam Basin SSC-T relationships (provided by USGS)

Site	Description	Regression Equation	R^2	Standard Error (Original Units)
North Santiam below Boulder Cr	Input to Detroit Reservoir	$SSC = 1.70\ T^{1.04}$	0.907	34.3
Breitenbush River above French Cr	Input to Detroit Reservoir	$SSC = 1.85\ T^{0.988}$	0.927	39.6
Blowout Cr Near Detroit	Input to Detroit Reservoir	$SSC = 1.44\ T^{1.08}$	0.915	30.8
North Santiam at Mehama, OR	Below Detroit Reservoir	$SSC = 1.90\ T^{0.752}$	0.888	24.5
North Santiam at Niagara, OR	Below Detroit Reservoir	$SSC = 2.00\ T^{0.633}$	0.598	15.3

The Mehama, OR location was selected because it represented a site located below a reservoir (Detroit), and because of the similarity in geology of the North Santiam and South Fork McKenzie watersheds. Suspended sediment samples taken (CUGRSD1- 4) at the USGS gage at Rainbow, OR during the drawdown were compared with the turbidity readings taken at the time of the sampling. These samples were plotted with the Mehama data set. To account for possible sampling error due to the sampling method, error bounds representing plus or minus 25 percent were applied to the five samples used for comparison (Figure 2). The plotting position of the drawdown samples fit well within the Mehama regression.

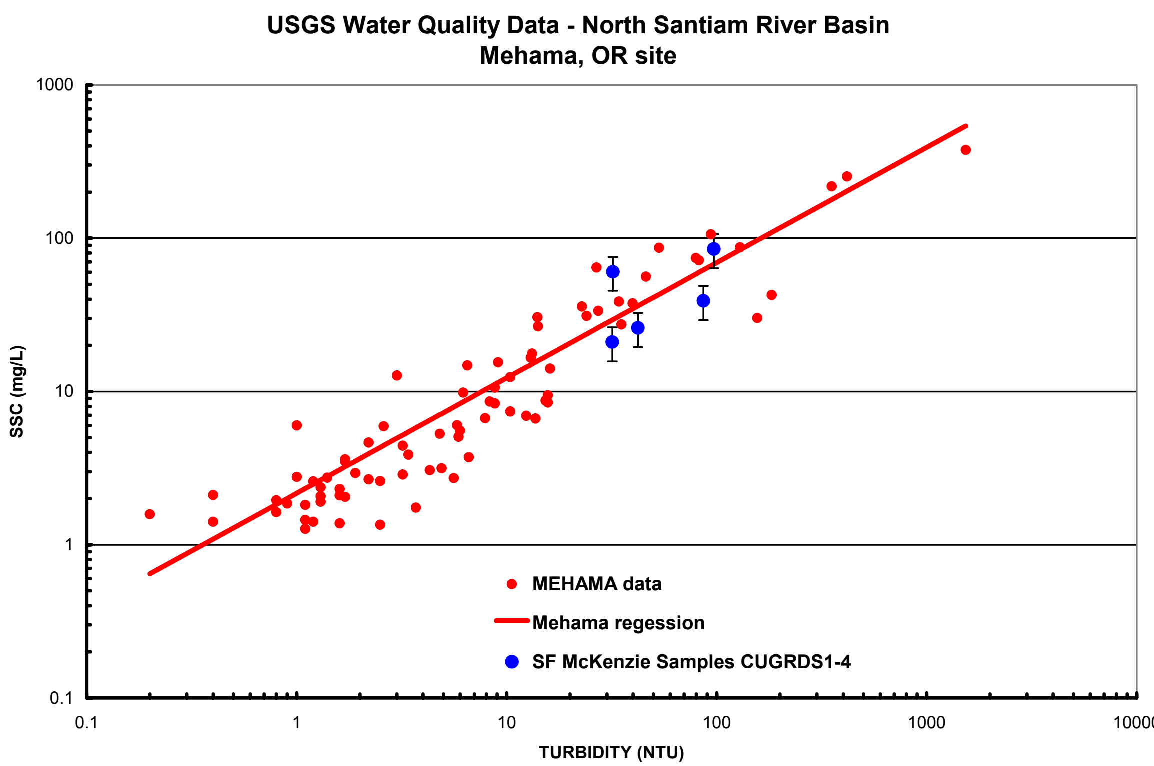

Figure 2 - USGS Water Quality Data, Mehama, OR, South Fork McKenzie river Samples CUGRDS1 - 4.

The Niagara SST-T relationship was not used because of the lower R^2 value suggesting a poorer correlation between SST-T at that site then at Mehama. This was in part due to a smaller data set at Niagara. The SST-T regressions for the two sites below Detroit were found to be similar, as were the three sites above Detroit reservoir.

Because the SSC-T relationships are watershed and site specific, use of the Mehama data to estimate SSC and sediment discharge below Cougar Reservoir provides at best, a gross estimate.

To estimate the SSC concentrations at the unusually high turbidity levels observed during the tunnel tap, laboratory analysis was conducted on reservoir sediment samples collected from inside Cougar reservoir (Sobecki, et al 2003). The reservoir sediment was suspended at several different concentration levels. Turbidity was measured at the different concentrations to define the SSC-T relationship at turbidity levels above 200 NTU.

For Mehama, OR the SSC-T relationship is given by:

(1) $SSC_M = 1.90 \cdot T^{0.752}$

where SSC_M = Suspended sediment concentration in mg/liter
T = Turbidity in NTU (Nephelometric Turbidity Units)

For high turbidity (greater than 200 NTU) the SSC-T relationship developed by laboratory analysis is given by:

(2) $SSC_L = 0.55 \cdot T + 83.45$

where SSC_L = Suspended sediment concentration in mg/liter
T = Turbidity in NTU (Nephelometric Turbidity Units)

Estimates of suspended sediment concentration are based on turbidity observed at the SF McKenzie near Rainbow, OR USGS gage, number 14159500 for SF McKenzie River below Cougar Dam are given by Eqs. (3) & (4):

(3) $SSC_{CGRO} = 1.90 \cdot T_{CGRO}^{0.752}$ Turbidity range 0 to 200 NTU, Standard Error = 24.5 mg/liter

(4) $SSC_{CGROH} = 0.55 \cdot T_{CGRO} + 83.45$ Turbidity range above 200 NTU

where SSC_{CGRO} = Estimated suspended sediment concentration in mg/liter below Cougar Dam
SSC_{CGROH} = Estimated suspended sediment concentration in mg/liter below Cougar Dam (turbidity above 200 NTU)
T_{CGRO} = Turbidity in NTU, measured at USGS gage

SUSPENDED SEDIMENT CONCENTRATION ESTIMATES FOR TUNNEL TAP AND DRAWDOWN EVENTS - SF MCKENZIE RIVER NEAR RAINBOW, OR. (BELOW COUGAR DAM) USGS GAGE ID 14159500

Estimates of suspended sediment concentration immediately below Cougar Reservoir are computed for four separate time periods during Spring 2002, for use in assessing the effect of high turbidity on fishes. The significance for selection of these time periods is discussed in the main body of the Supplemental Information Report.

The four time periods are:

1. 2/23/2002 ~ 1300 turbidity measurement below the reservoir - 1358 NTU (point estimate)
2. 2/23 to 2/27/2002
3. 4/09 to 6/06/2002
4. 4/28 to 5/30/2002

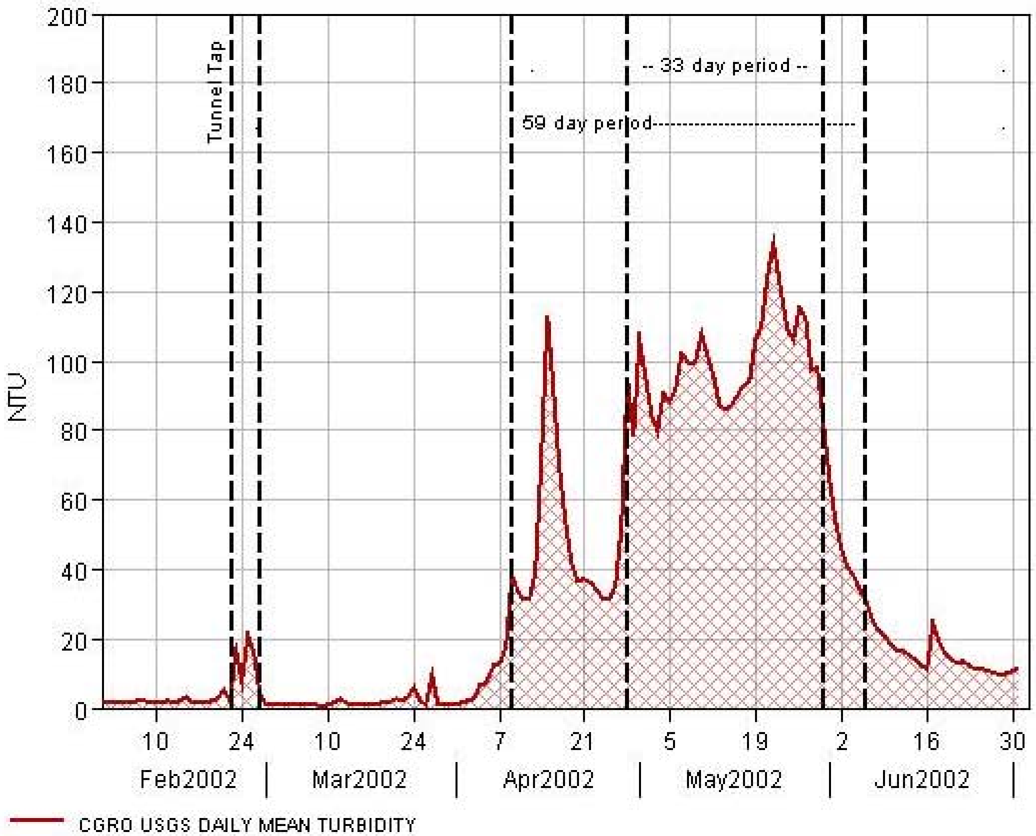

Figure 3 - Mean daily turbidity values, SF McKenzie River near Rainbow, OR. 2/01 - 7/01/2002

1. <u>Point estimate - 1358 NTU</u>

Using Eq (4) $SSC_{CGROH} = 0.55 \cdot T_{CGRO} + 83.45$

$$SSC_{CGROH} = 830.35 \frac{mg}{liter}$$

2. **5 day period 2/23 to 2/27/02**

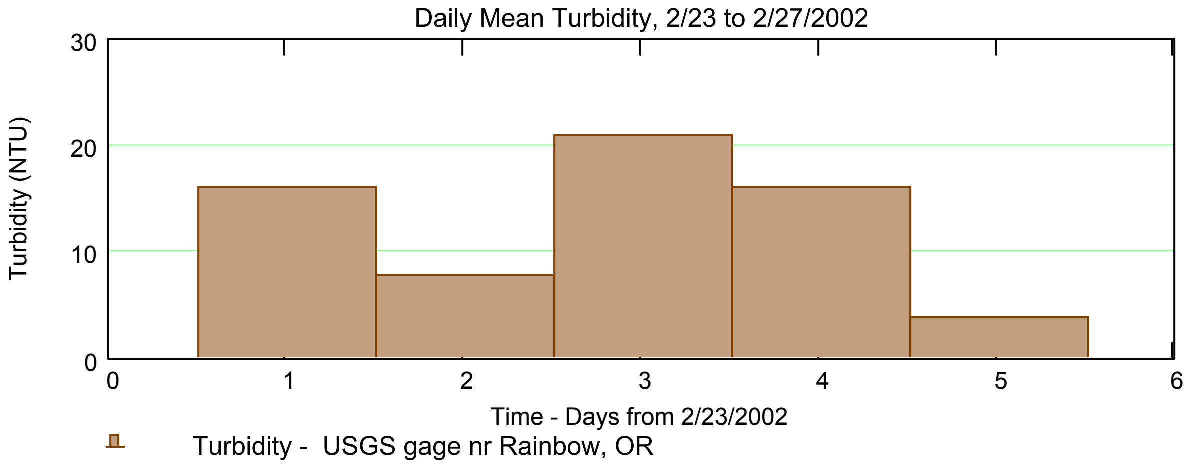

Figure 4 - Mean daily turbidity values, February 23 to 27, 2002

Using Eq (3) $SSC_{CGRO} = 1.90 \cdot T_{CGRO}^{0.752}$

Average turbidity over 5-day period $\mathrm{mean}(T_{CGRO}) = 12.9\ \mathrm{NTU}$

Average suspended sediment concentration over 5-day period $\mathrm{mean}(SSC_{CGRO}) = 12.7\ \frac{\mathrm{mg}}{\mathrm{liter}}$

3. 59 day period 4/09 to 6/06/2002

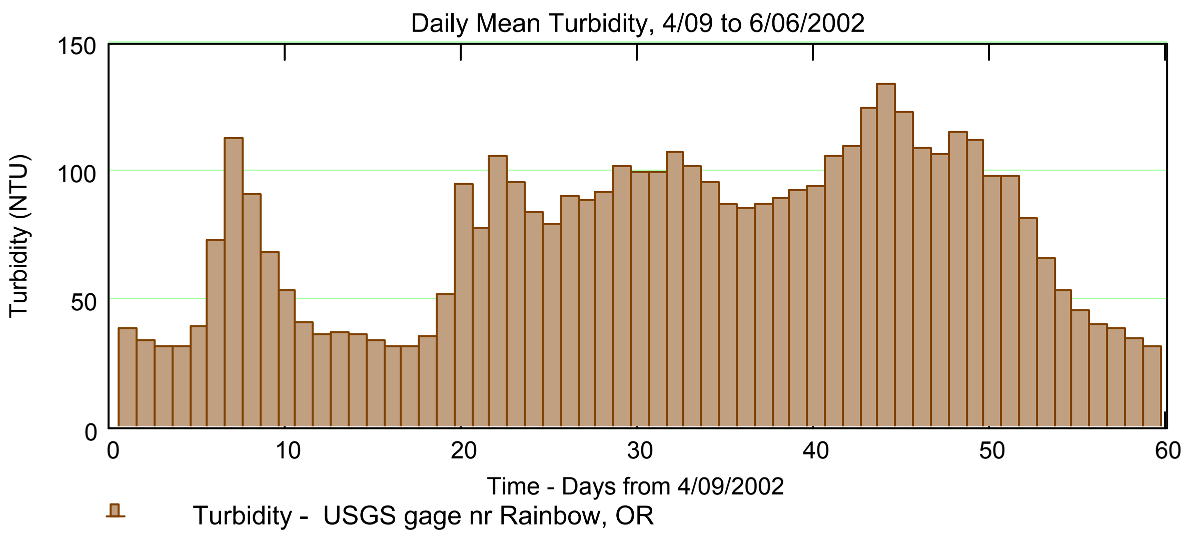

Figure 5 - Mean daily turbidity values, April 9 to June 6, 2002

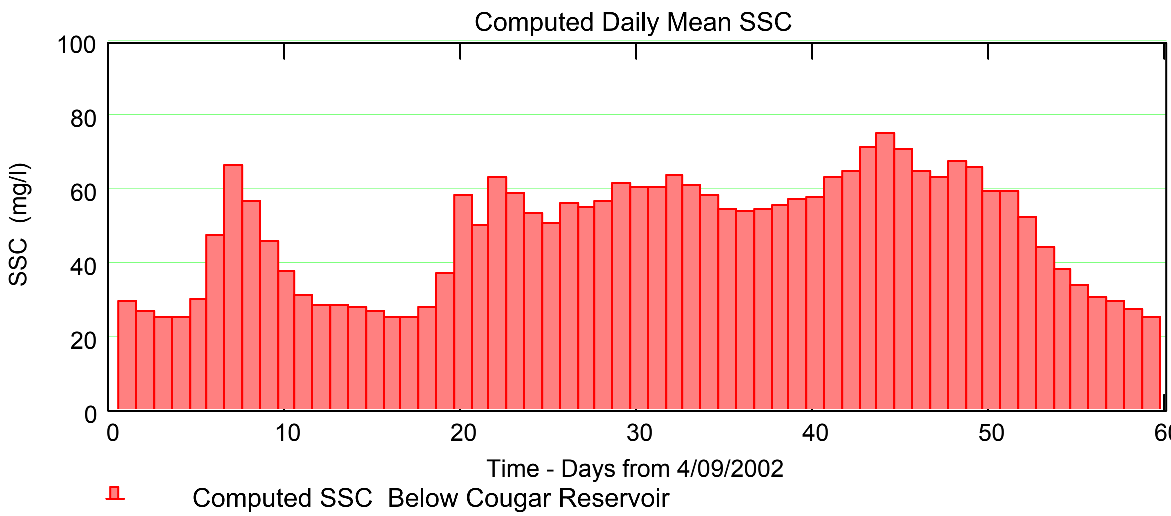

Figure 6 - Mean daily computed SSC April 9 to June 6, 2002

Using Eq (3) $SSC_{CGRO} = 1.90 \cdot T_{CGRO}^{0.752}$

Average turbidity over 59-day period $\mathrm{mean}\left(T_{CGRO}\right) = 76.1\ \mathrm{NTU}$

Average suspended sediment concentration over 59 day period $\mathrm{mean}\left(SSC_{CGRO}\right) = 48.5\,\frac{mg}{liter}$

4. 33 day period 4/28 to 5/30/2002

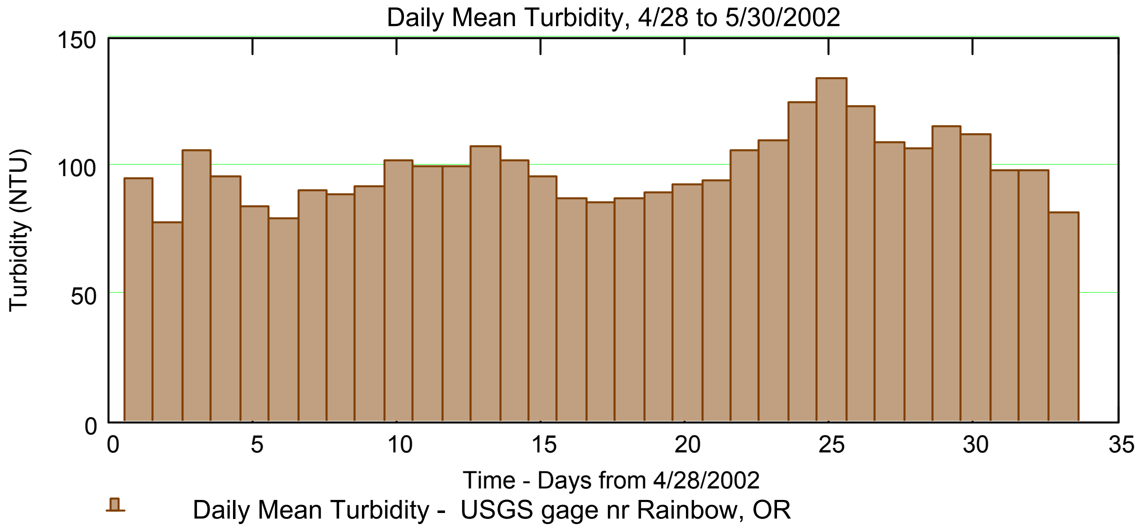

Figure 7 - Mean daily turbidity values, April 28 to May 30, 2002

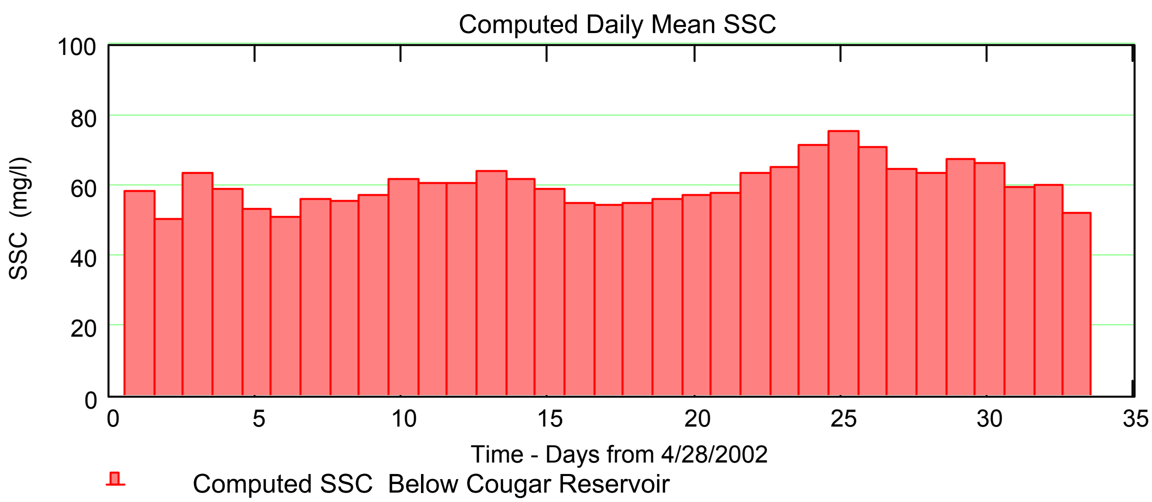

Figure 8 - Mean daily computed SSC, April 28 to May 30, 2002

Using Eq (3) $SSC_{CGRO} = 1.90 \cdot T_{CGRO}^{0.752}$

Average turbidity over 33-day period $\quad \text{mean}\left(T_{CGRO}\right) = 99 \text{ NTU}$

Average suspended sediment concentration over 33-day period $\quad \text{mean}\left(SSC_{CGRO}\right) = 60.1 \frac{\text{mg}}{\text{liter}}$

SEDIMENT DISCHARGE CALCULATIONS

Using the SSC-T relationship at Mehama, OR the estimated sediment discharge in tons from Cougar reservoir is computed for the period 4/01 to 7/01/2002

Daily mean sediment discharge is computed by the following equation:

(5) $q_s = Q \times c_s \times 1\text{day}$

where q_s - is sediment discharge in tons

Q - daily mean discharge in cubic feet per second

c_s - computed daily mean SSC in mg/liter

For Cougar reservoir, the daily mean discharge at USGS gage number 14159500 for SF McKenzie River below Cougar Dam is used to compute the sediment discharge below the dam.

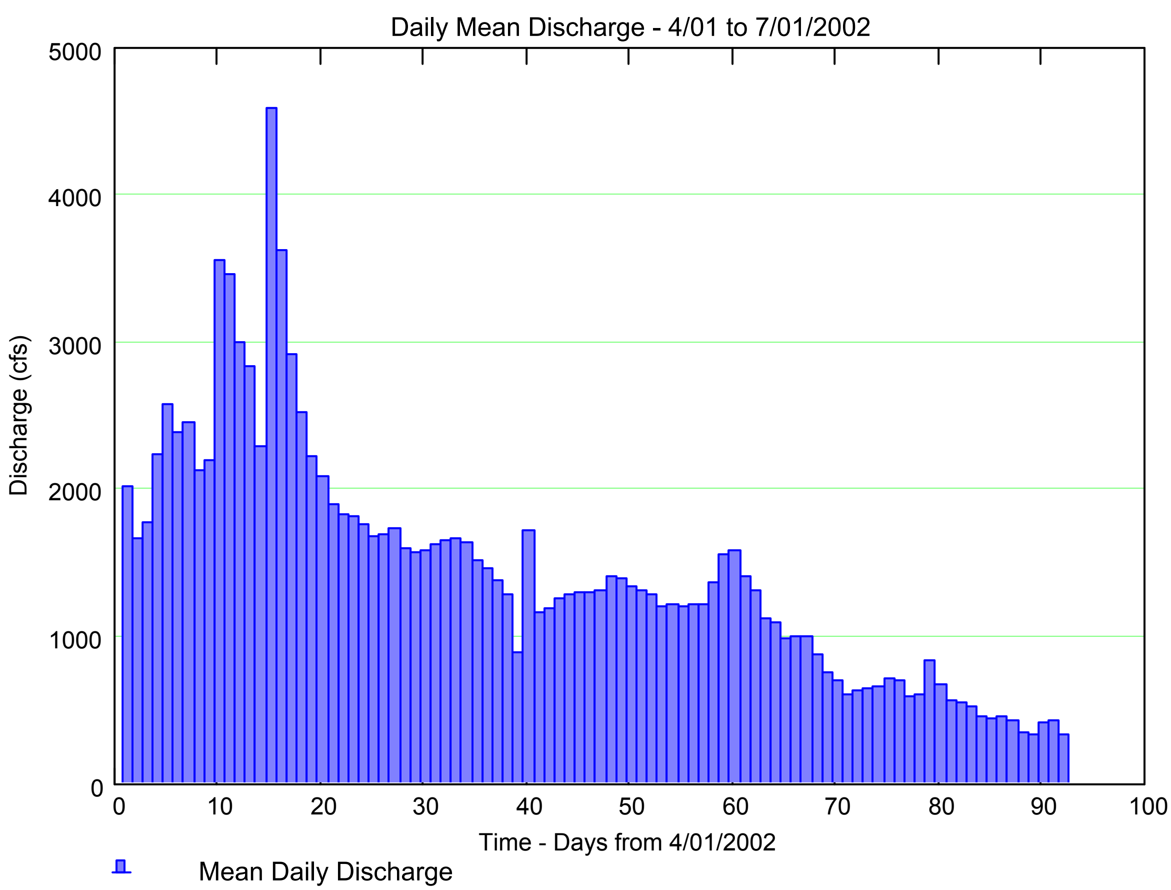

Figure 9 - Mean daily discharge, S. Fork McKenzie near Rainbow, OR, April 1 to July 1, 2002

Daily mean SSC is computed by Eq (3) $SSC_{CGRO} = 1.90 \cdot T_{CGRO}^{0.752}$

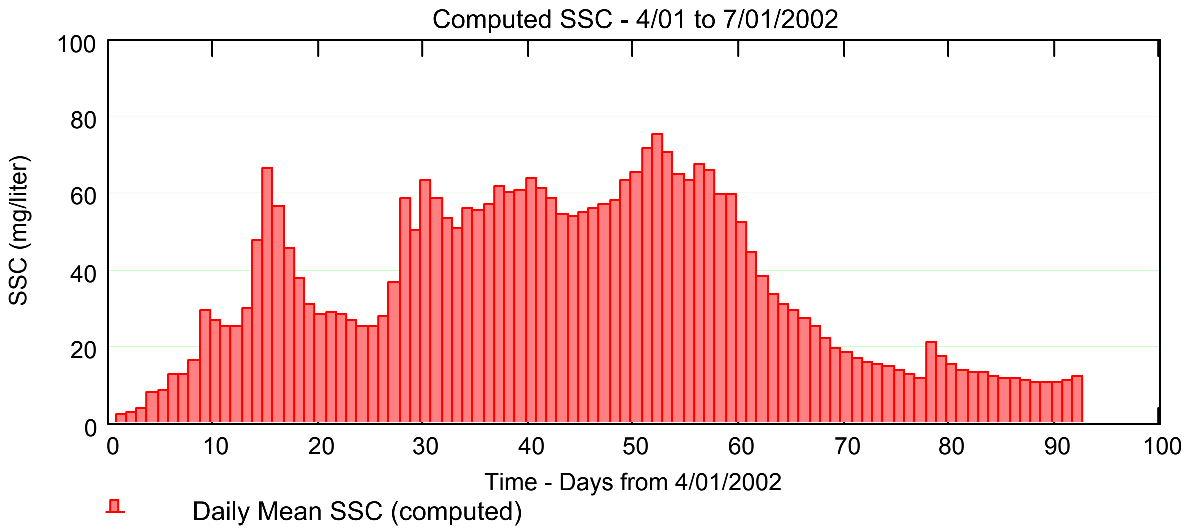

Figure 10 - Daily mean computed SSC, April 1 to July 1, 2002

Using daily mean SSC computed by Eq (3), sediment discharge is computed using Eq (5) $q_s = Q \times c_s \times 1\text{day}$

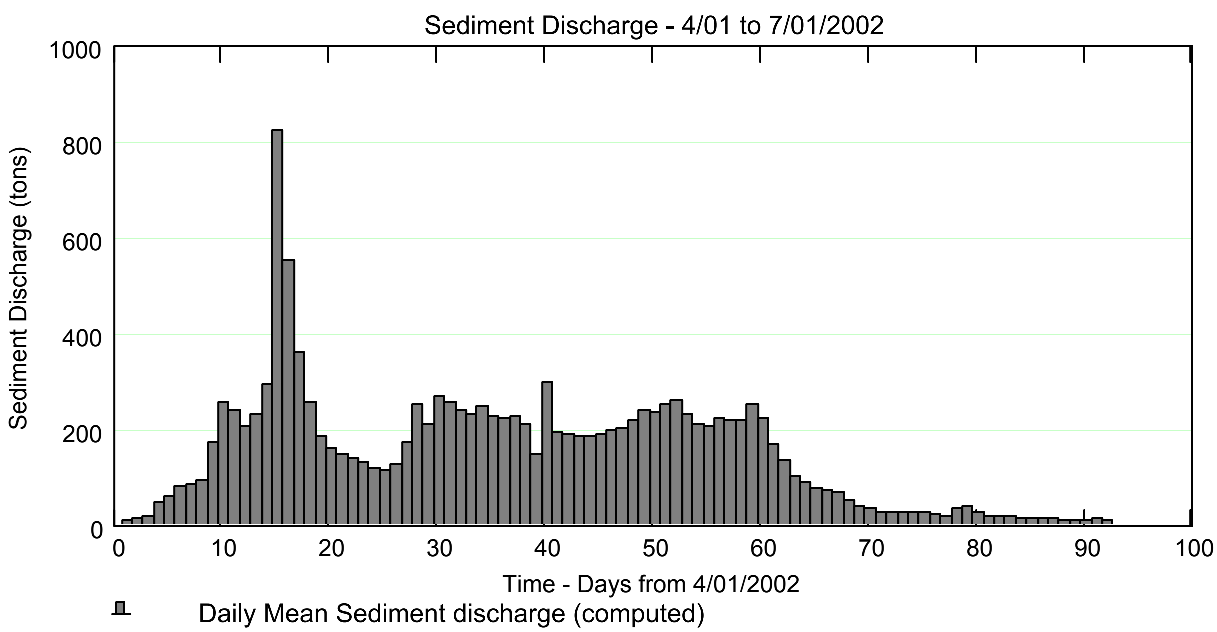

Figure 11 - Daily mean computed sediment discharge in tons from Cougar reservoir, April 1 to July 1, 2002

For the period 4/01 to 7/01/2002, the total computed sediment discharge was 13764 tons, the mean daily sediment discharge was 149.61 tons. Applying the standard error for Eq (1) of 24.5 mg/liter to the computed sediment discharge of 13764 tons, the error bounds for the estimate are computed below.

Average discharge 4/01 through 7/01/2002 - $\text{mean}(Q_{CGRO}) = 1443\,\text{cfs}$

Standard error, Eq. (1) - $SSC_{SE} := 24.5 \cdot \frac{\text{mg}}{\text{liter}}$

Error bounds are +/- $1443 \cdot \text{cfs} \times 24.5 \cdot \frac{\text{mg}}{\text{liter}} \times 92 \cdot \text{day} = 8772\,\text{ton}$

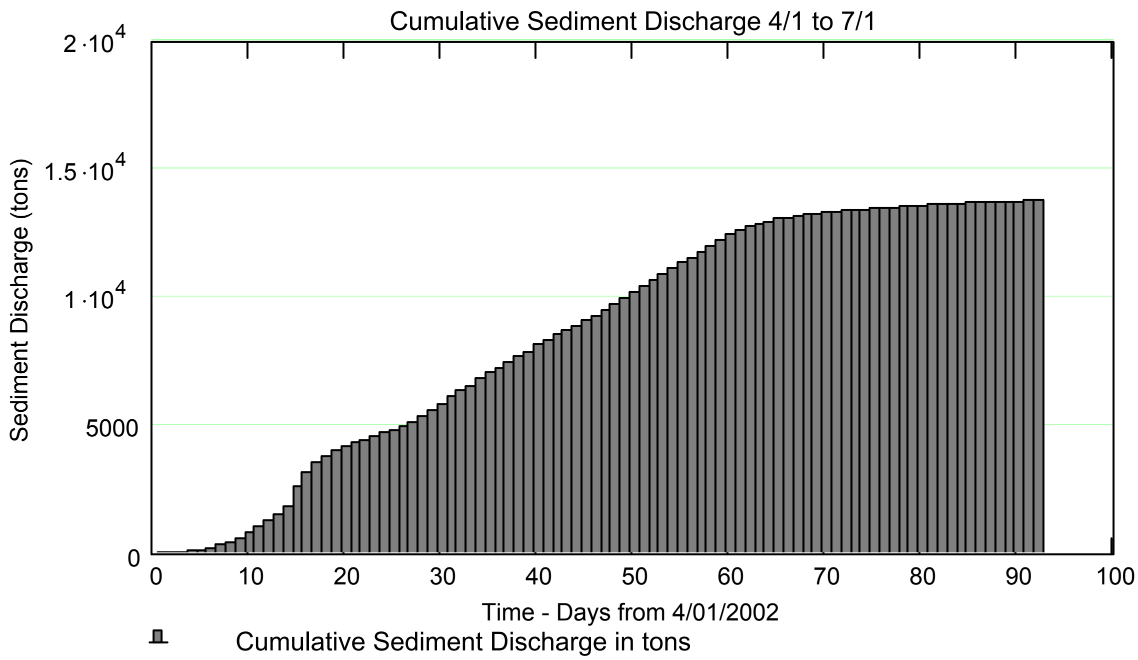

Figure 12 - Cumulative computed sediment discharge from Cougar reservoir in tons, April 1 to July 1, 2002

The estimated cumulative sediment discharge (Figure 12) between April 1 and July 1, 2002 is 13764 +/- 8772 tons or between 4992 and 22536 tons. Table 2 shows the computed daily mean SSC, computed daily mean sediment discharge, and the cumulative sediment discharge from April 1 to July 1, 2002.

Sample Calculations – SSC and Sediment discharge for May 10, 2002

Daily mean turbidity $T_{May10} := 107.50 \cdot NTU$

Daily mean discharge $Q_{May10} := 1716.10 \cdot cfs$ $\left(1716.10 \cdot \frac{ft^3}{sec}\right)$

Computed SSC using Eq (3) $SSC_{CGRO} = 1.90 \cdot T_{CGRO}^{0.752}$

$SSC_{May10} := 1.90 \times 107.50^{0.752}$ $1.90 \times 107.50^{0.752} \times \frac{mg}{liter} = 64.02842 \frac{mg}{liter}$

The computed daily mean SSC for May 1, 2002 is **64.03 mg/liter**

Computed sediment discharge for May 10, 2002 using Eq (5) $q_s = Q \times c_s \times 1day$

Convert daily mean discharge in cubic feet per second to cubic feet per day

$$1716.10 \cdot \frac{ft^3}{sec} \times 60 \cdot \frac{sec}{min} \times 60 \cdot \frac{min}{hr} \times 24 \cdot \frac{hr}{day} = 148271040 \frac{ft^3}{day}$$

Convert computed daily mean SSC in mg/liter to tons/cubic foot

$$64.02842 \cdot \frac{mg}{liter} \times 28.317 \cdot \frac{liter}{ft^3} \times 1.10231 \times 10^{-9} \cdot \frac{ton}{mg} = 1.99859 \times 10^{-6} \frac{ton}{ft^3}$$

Sediment discharge, q_s, is then computed:

$$q_s := 148271040 \cdot \frac{ft^3}{day} \times 1 \cdot day \times 1.99859 \times 10^{-6} \cdot \frac{ton}{ft^3}$$

$$q_s = 296.3\,ton$$

The computed sediment discharge for May 10, 2002 using Eq (3) and (5) is **296.3 tons**

Table 2 - Computed SSC, sediment discharge from Cougar Reservoir, April 1 to July 1, 2002

Date	Daily Mean Discharge (cfs)	Daily Mean Turbidity (NTU)	Computed Daily Mean SSC (mg/liter)	Computed Daily Mean q_s (tons)	Cumulative Computed q_s (tons)
01-Apr-02	2,013.7	1.2	2.18	11.8	11.8
02-Apr-02	1,669.0	1.9	3.08	13.9	25.7
03-Apr-02	1,770.0	2.4	3.67	17.5	43.2
04-Apr-02	2,239.7	6.6	7.85	47.4	90.6
05-Apr-02	2,576.8	7.4	8.56	59.5	150.1
06-Apr-02	2,387.6	12.6	12.77	82.2	232.4
07-Apr-02	2,447.7	12.8	12.92	85.3	317.7
08-Apr-02	2,125.4	17.8	16.56	94.9	412.6
09-Apr-02	2,190.4	38.5	29.58	174.7	587.3
10-Apr-02	3,548.9	33.9	26.88	257.3	844.6
11-Apr-02	3,462.2	31.6	25.50	238.1	1082.7
12-Apr-02	3,000.7	31.4	25.38	205.4	1288.1
13-Apr-02	2,839.0	39.2	29.99	229.6	1517.7
14-Apr-02	2,290.3	72.7	47.71	294.7	1812.4
15-Apr-02	4,592.1	112.7	66.34	821.6	2634.0
16-Apr-02	3,619.5	91.4	56.67	553.2	3187.2
17-Apr-02	2,916.1	68.7	45.72	359.6	3546.8
18-Apr-02	2,516.0	53.5	37.89	257.1	3803.9
19-Apr-02	2,217.2	41.4	31.24	186.8	3990.7
20-Apr-02	2,085.2	36.6	28.48	160.1	4150.8
21-Apr-02	1,899.3	37.1	28.77	147.4	4298.2
22-Apr-02	1,823.9	36.1	28.18	138.6	4436.8
23-Apr-02	1,813.5	33.8	26.82	131.2	4568.0
24-Apr-02	1,753.9	31.6	25.50	120.6	4688.6
25-Apr-02	1,679.4	31.6	25.50	115.5	4804.1
26-Apr-02	1,688.7	35.6	27.89	127.0	4931.1
27-Apr-02	1,729.8	51.8	36.98	172.5	5103.6
28-Apr-02	1,598.3	95.0	58.34	251.5	5355.1
29-Apr-02	1,564.4	77.9	50.26	212.0	5567.1
30-Apr-02	1,583.5	105.9	63.31	270.4	5837.5
01-May-02	1,620.4	95.9	58.76	256.8	6094.3
02-May-02	1,656.3	84.2	53.28	238.0	6332.3
03-May-02	1,667.3	79.4	50.98	229.2	6561.5
04-May-02	1,634.9	90.3	56.16	247.6	6809.2
05-May-02	1,517.6	88.3	55.22	226.0	7035.2
06-May-02	1,466.0	91.8	56.86	224.8	7260.0
07-May-02	1,374.0	102.2	61.64	228.4	7488.4
08-May-02	1,286.8	99.4	60.37	209.5	7697.9
09-May-02	894.9	99.6	60.46	145.9	7843.8
10-May-02	1,716.1	107.5	64.03	296.3	8140.1
11-May-02	1,164.0	101.7	61.41	192.8	8332.9
12-May-02	1,185.3	95.7	58.67	187.5	8520.4
13-May-02	1,261.9	86.9	54.56	185.7	8706.1
14-May-02	1,281.7	85.8	54.04	186.8	8892.9
15-May-02	1,297.6	87.2	54.70	191.4	9084.4
16-May-02	1,299.5	89.8	55.93	196.0	9280.4

Date	Daily Mean Discharge (cfs)	Daily Mean Turbidity (NTU)	Computed Daily Mean SSC (mg/liter)	Computed Daily Mean q_s (tons)	Cumulative Computed q_s (tons)
17-May-02	1,306.2	92.7	57.28	201.8	9482.1
18-May-02	1,403.0	94.0	57.88	219.0	9701.2
19-May-02	1,397.9	106.2	63.45	239.2	9940.3
20-May-02	1,343.1	110.0	65.14	236.0	10176.3
21-May-02	1,306.8	124.3	71.42	251.7	10428.0
22-May-02	1,284.3	133.8	75.48	261.4	10689.4
23-May-02	1,208.8	122.7	70.72	230.6	10920.0
24-May-02	1,213.8	109.0	64.70	211.8	11131.8
25-May-02	1,208.5	106.3	63.49	206.9	11338.7
26-May-02	1,220.6	115.3	67.49	222.2	11560.9
27-May-02	1,220.7	112.1	66.08	217.5	11778.4
28-May-02	1,370.9	97.7	59.59	220.3	11998.7
29-May-02	1,560.4	98.0	59.72	251.3	12250.1
30-May-02	1,579.4	81.9	52.18	222.3	12472.3
31-May-02	1,405.1	65.9	44.32	167.9	12640.3
01-Jun-02	1,312.2	53.8	38.05	134.6	12774.9
02-Jun-02	1,124.5	45.8	33.71	102.2	12877.1
03-Jun-02	1,095.6	40.6	30.79	91.0	12968.1
04-Jun-02	991.1	38.4	29.52	78.9	13047.0
05-Jun-02	995.5	34.4	27.18	73.0	13120.0
06-Jun-02	999.6	31.6	25.50	68.7	13188.7
07-Jun-02	871.7	26.3	22.21	52.2	13240.9
08-Jun-02	753.9	22.5	19.75	40.2	13281.1
09-Jun-02	697.9	20.6	18.48	34.8	13315.9
10-Jun-02	607.1	18.1	16.77	27.5	13343.3
11-Jun-02	626.0	16.5	15.64	26.4	13369.7
12-Jun-02	641.1	16.1	15.36	26.6	13396.3
13-Jun-02	654.4	15.2	14.71	26.0	13422.3
14-Jun-02	719.9	14.0	13.82	26.8	13449.1
15-Jun-02	702.4	12.4	12.62	23.9	13473.0
16-Jun-02	596.8	11.2	11.69	18.8	13491.8
17-Jun-02	607.0	24.2	20.86	34.2	13526.0
18-Jun-02	840.0	19.2	17.53	39.7	13565.7
19-Jun-02	675.2	15.8	15.14	27.6	13593.2
20-Jun-02	559.9	13.9	13.75	20.8	13614.0
21-Jun-02	551.8	13.2	13.23	19.7	13633.7
22-Jun-02	518.5	13.3	13.30	18.6	13652.3
23-Jun-02	450.9	12.2	12.47	15.2	13667.4
24-Jun-02	439.0	11.1	11.61	13.7	13681.2
25-Jun-02	449.7	11.2	11.69	14.2	13695.4
26-Jun-02	426.3	10.8	11.37	13.1	13708.4
27-Jun-02	352.4	10.2	10.89	10.4	13718.8
28-Jun-02	336.6	9.7	10.49	9.5	13728.3
29-Jun-02	415.6	10.0	10.73	12.0	13740.4
30-Jun-02	427.5	10.4	11.06	12.7	13753.1
01-Jul-02	326.4	12.0	12.31	10.8	13763.9

DECEMBER 2002 – JANUARY 2003 OBSERVED TURBIDITY

The 1400 foot residual pool has been maintained through the fall and winter. The weather pattern produced several storms which raised the reservoir elevation to 1411 feet on December 31st and 1413 feet on January 5th. The highest turbidity occurred on December 31st at 202 NTU. Turbidity levels rose again and reached 117 and 113 NTU on January 3rd and 5th respectively. The sharp increases in turbidity were due to erosion at the 1405 to 1411 foot level in the reservoir and increased turbid inflows from the tributaries draining the reservoir. Turbidity levels quickly dropped when the reservoir releases were sharply increased to bring the reservoir pool back to the 1400-foot level. Figure 13 shows the observed reservoir elevation plotted against the observed flow and turbidity downstream at the USGS gage near Rainbow, OR.

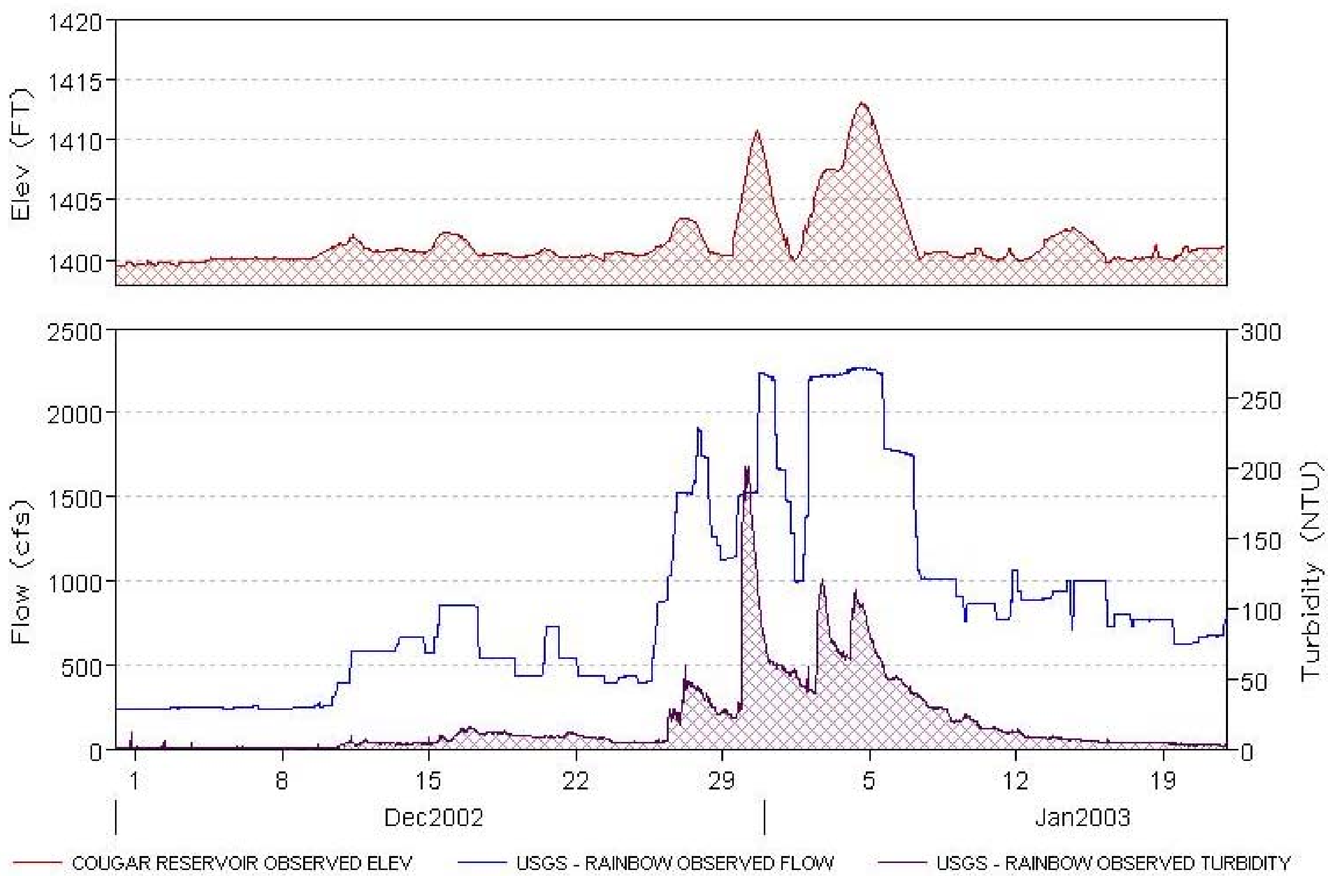

Figure 13 - Observed Cougar Reservoir elevation December 2002 - January 2003. Observed discharge and turbidity USGS gage 14159500 SF McKenzie near Rainbow, OR

SEDIMENT GRAIN SIZE CLASSIFICATION - TERMINOLOGY

Particle size is the most significant physical property of sediment. Sediment particles are classified, based on their size, into six general categories: *Clay, Silt, Sand, Gravel, Cobbles,* and *Boulder*s. Because such classifications are essentially arbitrary, many grading systems are to be found in the engineering and geologic literature. Table 3 shows a grade scale proposed by the subcommittee on Sediment Terminology of the American Geophysical Union. This scale is adopted for sediment work because the sizes are arranged in a geometric series with a ratio of two. (O'Brien, 2000)

Table 3 - American Geophysical Union Sediment Classification System (USACE EM-1110-2-4000)

	Sediment Size Range		
Sediment	millimeters	microns	Inches
Very large boulders	4096 - 2048		160-80
Large cobbles	256 - 128		80-40
Medium boulders	1024 - 512		40-20
Small boulders	512 - 256		20-10
Large cobbles	256-128		10-5
Small cobbles	128-64		5-2.5
Very coarse gravel	64-32		2.5-1.3
Coarse gravel	32 - 16		1.3-0.6
Medium gravel	16 - 8		0.6-0.3
Fine gravel	8 - 4		0.3-0.16
Very fine gravel	4 - 2		0.16-0.08
Very coarse sand	2.0 - 1.0	2000-1000	
Coarse sand	1.0 - 0.5	1000-500	
Medium sand	0.5 - 0.25	500-250	
Fine sand	0.25 - 0.125	250-125	
Very fine sand	0.125 - 0.062	125-62	
Coarse silt	0.062 - 0.031	62-31	
Medium silt	0.031 - 0.016	31-16	
Fine silt	0.016 - 0.008	16-8	
Very fine silt	0.008 - 0.004	8-4	
Coarse clay	0.004 - 0.002	4-2	
Medium clay	0.002 - 0.001	2-1	
Fine clay	0.0010 - 0.0005	1.0 - 0.5	
Very fine clay	0.0005 - 0.00024	0.5 - 0.24	

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SOFTWARE USED

Calculations made using *Mathcad 2001i Professional*, © 1986-2001 MathSoft Engineering & Education, Inc.

AMENDMENT FOR NEPA COVERAGE FOR
COUGAR LAKE
INTAKE STRUCTURE MODIFICATIONS
WILLAMETTE TEMPERATURE CONTROL
MCKENZIE SUBBASIN, OREGON

1. An Environmental Assessment (EA) was prepared for the Cougar Lake Intake Structure Modifications and released for public and agency review under Public Notice CENPW-EC-E-99-04 on July 15, 1999. A Finding of No Significant Impact was signed on November 30, 1999. This EA supplemented the Final Environmental Impact Statement on the Willamette Temperature Control Project, Cougar and Blue River Lakes, released in April 1995.

2. Project construction activities, i.e., drawdown of the reservoir through the newly opened diversion tunnel, resulted in more turbidity than had been anticipated and described in the FEIS and the 1999 EA. Corps regulations for implementing NEPA, ER200-2-2,13(d), provides for publishing additional supplemental information documents on long-term or complex Environmental Impact Statements (EISs) to keep the public informed. It was decided to prepare a supplemental information report (SIR) to address turbidity and to investigate whether the turbidity had caused significant impacts to the river environment. This amendment to the 1999 EA addresses effects of the unexpected turbidity from 2002, the management option to control turbidity during construction in 2003 and 2004, and new information.

3. Since the draft SIR and Environmental Assessment amendment were released for public review on January 30, 2003, two relevant events occurred. One was a storm event in late January, following several other winter storm events. Concurrent with the January 30 storm was a failure of the Rush Creek diversion outlet pipe. Following the initial elevated turbidity resulting from the failure, the pool was raised to 1,450 to cover the eroding slope below Rush Creek outlet. The slope failure caused an immediate spike in the turbidity downstream of the reservoir of 1,030 NTUs on January 30, 2003. The turbidity level dropped to 450 NTUs within 1 day and fell to 83 NTUs by February 3, 2003. While the slope failure caused an immediate spike, channel downcutting and migration by the South Fork McKenzie from January 30 to 31, 2003, resuspended a large amount of sediment contributing to the high turbidity observed downstream. (O'Brien, et al. 2003)

Once the situation stabilized, turbidity returned to 2 NTUs by March 3, with occasional short-term increases due to rain or slope slump elsewhere in the reservoir. Based on surveys of the failed slope, the failure area is confined to overburden and has not impacted the toe of the dam. The Corps will continue to operate at 1,450 and monitor the slope to assess if any repairs are required. At this point, no repair action is planned. The Corps will continue to monitor the situation.

4. Proposed Action. The proposed action is to continue the construction of intake structure modification at Cougar Dam, while operating the reservoir in a manner to minimize turbidity in the South Fork McKenzie and McKenzie Rivers during the spring fly-fishing season (April-May).

To reduce the intensity or duration of another high turbidity event during April such as occurred in 2002, the Corps investigated possible operational changes. The options considered included 1)increasing the drawdown rate below pool elevation 1,532 feet; 2) adjusting the winter flood control pool elevation; and 3) adjusting the target date to reach construction pool of 1,400 feet. Advantages and disadvantages of the options are described in the SIR.

The preferred alternative for operation of Cougar reservoir during the winter and spring of 2003 and 2004 was the low pool/6 feet/day drawdown option. The Corps would attempt, as much as possible, to maintain the pool at elevation 1,400 feet during the winter. When the pool exceeds 1,400 feet, then drawdown will be at the 6 feet/day rate. If the winter is wet, or if heavy rain occurs during the late winter/early spring, the pool elevation will be above 1,400 feet for short periods. Analysis and observation of conditions during the 3 feet/day drawdown has lead the Corps to consider a faster drawdown of up to 6 feet/day. The Corps geotechnical staff believes that a drawdown rate higher than 6 feet/day could cause excessive slumping of shoreline and possible damage to the dam.

The action for the remaining 2 years of construction is to maintain the pool at elevation 1,450 instead of 1,400. All other elements remain the same as proposed in the draft EA.

5. <u>Affected Environment</u>. The general affected environment is the same as that described in the previous EIS and EA. Some specific elements, such as recreation-related commerce and natural turbidity of the South Fork McKenzie and McKenzie Rivers, were not described. The presence of Oregon chub in the lower McKenzie River was discovered in 2000. DDT has been discovered in sediments exposed during reservoir drawdown.

<u>Recreation-related Commerce</u>. A description of recreation-related commerce, including river guides operating on the McKenzie River, was not included since impacts to this recreational industry was not identified. Several businesses, including river guides, lodges, retail stores selling fishing licenses and gear, food marts, service stations and restaurants are located along the McKenzie River and cater to recreationists throughout the year. While other river-oriented recreational activities occur throughout the year, fly-fishing is limited to the Spring season. For some businesses, particularly river guides, revenue from fly-fishing during March, April and May, constitutes a major portion of their annual income. A portion of other recreation-related businesses' income also derives from the fly-fishing season.

<u>Turbidity</u>. Natural turbidity in the South Fork McKenzie River can exceed 300 NTUs during winter and spring storms. Turbidity has been delayed and sediments diluted in Cougar Lake, thus that since the construction of Cougar Dam, turbidity in the lower South Fork and the McKenzie River has not been as high during the winter and spring months as pre-dam conditions. Turbidity recorded in January 1990 at Goodpasture Bridge exceeded 13 NTUs. Had Cougar/Blue reservoirs not been in place, the turbidity would have been much higher. Prior to the dam, high turbidity events would have cleared quickly from the McKenzie system. Over the last 40 years one of the impacts of the dam has been to dampen these high turbidity events. The dam causes turbidity downstream from these events to be lower and spread over a longer period.

<u>Oregon chub</u>. In the fall of 2000 a viable population of Oregon chub, listed as endangered under the Endangered Species Act, was discovered in the lower McKenzie River near Springfield, Oregon. In addition, a small population of Oregon chub was discovered in the Mohawk River, a

tributary of the McKenzie, known to contain agricultural runoff. A memorandum to the file documenting a no effect determination has been prepared. USFWS concurred.

DDT. In February 1996, 12 surface grab sediment samples were submitted for physical analysis and chemical analyses. These samples were collected, from within the reservoir, at the 1,400 feet contour near the intake structure and diversion tunnel and several upstream locations. No organic contaminates were detected above method detection levels (MDL). Although the 1996 sampling of reservoir sediments found no DDT, this pesticide was sprayed throughout the watershed (1949-1951) and still remains in surrounding forest duff and soil. DDT was banned in 1972. In 2002 eight water samples were taken between mid-May and mid-June during a range of turbidities. No contaminants were detected above established EPA concern levels (EPA, 1986) in any sample. A trace of DDT was detected in this sample at 0.000599 ug/L, which was also not confirmed in the duplicate sample. The lack of detection of these parameters in the duplicate sample lends credence to the view that, if the chemicals were in the sample, they were there in very low concentrations. This is below the EPA freshwater acute (1.1 ug/L) and chronic (0.001 ug/L) water quality criteria for DDT.

As a result of questions raised about potential contaminate levels in the turbidity and possible sediment releases, 12 surface sediment samples, targeting fine-grained sediment and organic material, were collected in June 2002. These samples were collected to target fine-grain and organic material that had been eroded during the drawdown, with one sample to represent lakebed sediments exposed after the drawdown event. All samples were submitted for physical parameters including total volatile solids and five samples were chemically analyzed for heavy metals (nine inorganic), total organic carbon, pesticides and polychlorinated biphenyls (PCBs), phenols, phthalates, miscellaneous extractables and polynuclear aromatic hydrocarbons (PAHs).

No PCBs were found at the Method Detection Limit (MDL) in any of the five June samples. No pesticides (except DDT and derivatives) were found at the MDL in any of the samples.
The following stations were tested for DDT and its breakdown components, DDE and DDD (expressed as Σ DDT) (with corresponding levels as indicated): two samples were collected from East Fork cut banks (Σ DDT @ 8.5 and 32.6 ppb), one sample below the Slide Creek boat ramp, from a cut bank area (Σ DDT @ 23.9 ppb), one sample from the Annie Creek delta (Σ DDT @ 18.6 ppb), and one sample was collected from lake deposits near the face of the dam on the Rush Creek side (Σ DDT @ 5.3 ppb).

Fifteen additional samples were collected in August 2002 and analyzed for physical properties, total organic carbon (TOC) and Σ DDT. Two background samples were collected from the South Fork of the McKenzie above the reservoir (no Σ DDT detected, less than 2.6 percent fines); three vertical profile samples from the cut-bank areas where only the fine-grained sediment was targeted in June (7.27, 7.11 and 17.65 parts per billion [ppb]); five surface composite sediment samples collected from the reservoir to represent the recently eroded and homogenized sediment during the drawdown event (non-detect [ND] @ 0.7 ppb detection level), 1.08, 4.77, 6.19 and 25.87 ppb). Each of these five samples analyzed were a composite of two to three surface grabs from a designated area of the reservoir; two surface samples from the McKenzie River, downstream of the dam (both ND @ less than 0.7 ppb) in slack water areas, where Σ DDT might have been deposited, if it had migrated beyond the confines of the reservoir. One upland station was sampled on a logging road cut bank. Samples represented the surface to 6-inch depth and 6-12 inch depth of forest floor debris (Σ DDT @ 374.6 ppb top 6 inches) and (Σ DDT @ 36.9 ppb 6–12 inch depth). (For more details see Appendix B of the SIR).

It is likely that some floating organic debris (fir needles, twigs, etc.), binding DDT, was released from the reservoir during the initial drawdown, but this material was likely distributed over a very large area, and not measurable nor posing any significant exposure to organisms, due to the wide distribution of this material. Because Σ DDT is hydrophobic (little affinity for water) it will tend to remain bound to the organic material and not be released to the water column. (See SIR, Appendix B.)

Aquatic Vegetation. There have been anecdotal reports of increased plant growth in the mainstem McKenzie since construction began at Cougar Dam in 2001. A combination of decreased light, increased turbidity, possibly increased nutrients such as phosphorus and organic carbon, and different water temperatures may have increased plant growth in the mainstem McKenzie. Or, the increased plant growth may have been a normal between years variation. Once construction of the modified intake tower is over, conditions should return to as before except for one environmental variable - temperature. Temperature in the South Fork is expected to return to pre-dam conditions.

6. Environmental Effects. The presence of turbidity and possible effects of turbidity, including sediment settling, in the South Fork and mainstem McKenzie Rivers were analyzed in regards to fish, spawning gravel and macroinvertebrates (insects). Effects of turbidity on esthetics, the Spring trout fishing season, and treatment of drinking water was also considered. No detectable DDT was found in sediment samples taken below Cougar Dam. A no effect determination has been made for Oregon chub.

Effects of Turbidity. The impact of turbidity on water quality was mainly related to esthetics. The turbid water below the project during April through May was unusual for this time of year, at least for the last 40 years since the project was built, and was esthetically displeasing. Contaminants analysis revealed that no water quality criteria were violated for any contaminant of concern, including metals, PAHs, oganochlorinated pesticides, chlorinated herbicides, and organophosphorus pesticides. Oxygen, temperature, pH and conductivity levels were within normal limits. Particles in the water contributing to the turbidity were mostly clay-sized that remain in suspension for a long time. State turbidity standards were exceeded; however, this was expected to occur for the South Fork. Oregon Department of Environmental Quality (ODEQ) provided a list of reporting and management requirements should turbidity be visible in the mainstem McKenzie. The Corps has complied with the State's requirements.

Drawdown of Cougar Reservoir below its normal minimum pool level of 1,532 feet to the construction pool level of 1,400 feet resulted in substantial erosion of unvegetated soil surrounding the pool. The major tributary drainage streams flowing into the reservoir, the South Fork McKenzie, East Fork McKenzie, and Walker Creek, re-established channels to the lower pool at the 1,400 foot level. These processes transported large amounts of sediment into the newly created lower pool area at 1,400 feet. Detention time in the construction pool was sufficient to allow the bulk of the coarser grained sediment mass to settle out. Much of the fine-grained sediment mass (silt-clay fraction, grain size smaller then 62 microns) was released from the reservoir during the period from April 1 to May 25, 2002 when the pool level reached 1,400 feet. The fine grained material released from the reservoir caused extended elevated turbidity in the South Fork McKenzie to the confluence and into the mainstem McKenzie Rivers. Visual observation of the South Fork McKenzie River gravel bed below Cougar Reservoir and of the mainstem McKenzie River below its confluence with the South Fork indicated the presence of a thin layer of silty material following the sustained releases of highly turbid water from Cougar

Reservoir. This material did not accumulate on the surface of the gravel bed but was flushed through the system during subsequent high flows. In addition, some of the fine sediment in suspension accumulated in the algae covering the gravel bed, changing the color of the algae from green to gray.

In 2003, it was proposed that the reservoir elevation be held as close to 1,400 feet as possible, and that a reservoir drawdown rate of 6 feet per day be used to accomplish and maintain this. The impact of this operation on turbidity during late spring storm events will depend on pool elevation. If the pool is successfully maintained at elevation 1,400 feet, turbidity will be higher because there is less volume to dilute the suspended sediment, but the turbid water will clear more quickly because of a reduced retention time. If the lake elevation is higher, the turbidity may be less but clearing of the pool will take longer. The drawdown rate of 6 feet per day will help to clear the reservoir of turbid water faster than the slower drawdown rate of 3 feet per day did in 2002. Spring storms could still result in increased turbidity below the dam but the turbidity will be of shorter duration.

The Corps has maintained the residual pool at (or close to) 1,400 feet since May 2002 until January 30, 2003. A December rainstorm increased incoming flows and turbidity, resulting in the pool rising to 1,411 feet, and releases of turbidity up to 200 NTUs on December 30. Incoming turbidity in the South Fork reached 24 NTUs late on the 29th of December, thus the downstream turbidity was a about 10-fold increase, as originally predicted. Turbidity at Hayden Bridge rose to 24 NTUs during that storm. (Average for December was 3.72 NTUs at Hayden Bridge.) (EWEB, pers. comm. Jan. 2003) The Corps was able to draw the reservoir back to 1,400 feet by January 1, 2003. Another rain event elevated the pool to 1,413 on January 5; however turbidity remained below 120 NTUs and dropped below 10 NTUs by January 8. Turbidity in January has not exceeded 120 NTUs, and generally has been between 55 NTUs and 3 NTUs (as of January 22, 2003).

Holding the reservoir at 1,400 feet during the winter did help regulate the turbidity until the January 30 storm when the Rush Creek outlet failed. Incoming turbidity in the South Fork during this January storm was about 78 NTUs. With the Rush Creek outlet failure, turbidity briefly (a one-half hour reading) exceeded 1,000 NTUs below the dam, and reached 100 NTUs on the mainstem McKenzie at Vida for a similar time period. As noted above, this cleared by early March. Turbidity during the March-April fly fishing season was, for the most part, near normal. In the March to May time period, incoming turbidity ranged from 30 to 0 NTUs; turbidity below the dam varied mostly between 25 and 2 NTUs, with one spike of 55 NTUs. Turbidity at Vida stayed between 15 and 1 NTUs with one spike of about 50 NTUs corresponding with the spike below the dam. Thus, managing the reservoir at elevation 1,450 during this period kept turbidity in the mainstem McKenzie within successful fishable limits. And, although the river was high, good insect hatches were reported (*The Register-Guard*, April 3, 2003). In addition, the coffer dam was not breached, and construction continued all winter and spring seasons, keeping the project on schedule. The Corps expects that turbidity in the Spring of 2004 will be greatly reduced from the 2002 levels.

DDT in Sediment. Total DDT was exposed in cutbank areas within the reservoir, which eroded into the post-drawdown 1,400 foot pool, but was not measurable downstream of the dam. Total DDT levels detected within the 1,400 foot pool were 4.8, 6.2, 1.1, ND @ less than 0.6, and 25.9 ug/kg (ppb). Further erosion will occur within the pool, but will likely be less than the original drawdown event and will therefore not create further risk downstream. The sediments within the reservoir will be further redistributed with upcoming winter and spring events. Monitoring after the final deposition and distribution within the reservoir would be warranted to determine if natural attenuation will sufficiently isolate the Σ DDT from potential uptake by benthic organisms.

Four of five sediment samples collected within the reservoir did not detect Σ DDT above levels of concern. Sediment will continue to be deposited onto the reservoir bottom. The current area, within the reservoir, where Σ DDT exceeds reference levels of concern, is limited and will likely change with future deposits. This area should be continually monitored, as should the area below the dam.

No Σ DDT, at MDLs, was detected in sediment samples collected below Cougar Reservoir. A no effect determination has been made for this area.

Spawning Gravel. Results of core samples taken of the spawning gravels in the South Fork McKenzie River below Cougar Reservoir and in the mainstem McKenzie River showed higher accumulation of fine sediments in the samples in the South Fork McKenzie than was present in the samples from the mainstem McKenzie River. Further analysis of the mainstem McKenzie River samples did not find clear evidence of Cougar Reservoir sediments based on the clay mineralogy (Stewart et al., 2002). These results suggest that relatively little of the sediment discharge from Cougar Reservoir settled in any one location in the mainstem McKenzie, though as discussed above, a fine dusting of deposited material was evidenced. The analysis by Stewart et al. (2002) also cannot ascertain when sediments were deposited below Cougar Dam. They may have accumulated over the 40 year time period in which the reservoir has been in place.

While accumulation of fine sediment has occurred below Cougar Dam over an unknown time period, the high turbidity events during Spring 2002 were unlikely to have had long-term negative impacts on spawning gravel quality below Cougar Dam. However, assessment of the rate of fine sediment accumulation in gravel areas during future storm events over the winter of 2002-2003 was planned to aid in better understanding the dynamics of fine sediment transport and deposition, and its effects on habitat. Because of so few winter storms in 2003 and because of late receipt of FY 03 appropriation, the sediment trap studies could not be conducted this year. They are still under consideration for 2004, subject to the availability of funding.

Macroinvertebrates. The abundance of organisms, species diversity, and presence of species sensitive to high levels of turbidity that were found in aquatic macroinvertebrate samples collected from areas located downstream of Cougar Dam indicated that this area was not heavily impacted by the relatively high turbidity events of spring 2002. Analysis indicated that the macroinvertebrate community below the dam was degraded in comparison to the community located above the reservoir. However, this is not unusual for areas located below dams, and this trend was also indicated in samples collected during 2000 and 2001 prior to drawdown of Cougar Reservoir (SIR, Figure 5). Indexes of biotic and habitat integrity (Wisseman 1996) ranged from moderate to low integrity for sampling stations located downstream of Cougar Dam. It was reported in the Eugene *Register-Guard* (April 3, 2003) that there were “good insect hatches” in the McKenzie River, which would support the Corps’ analysis.

Fisheries. The high turbidity events of spring 2002 had only minor, transient, impacts on fishes directly and relatively little effect on their habitat. Application of a scoring system developed by Newcombe and Jensen (1996) for relating magnitude (i.e., concentrations) and duration of suspended sediment events to effects on salmonids resulted in scores (z) ranging from 6 to 8 for levels of turbidity occurring directly below Cougar Dam. These scores indicate that impacts to salmonids in the South Fork McKenzie River resulting from the high turbidity events of spring 2002 may have ranged from moderate physiological stress ($z=6$) to reduction in feeding rate ($z=8$) during the period of high turbidities. No mortalities, however, ($z\geq10$) were indicated.

Assessments of condition for multiple fish species sampled both from below Cougar Dam and from within the residual pool above the dam by ODFW biologists and pathologists failed to detect health-related problems and documented that most fishes sampled were actively feeding and in good condition.

<u>Aquatic Vegetation</u>. For the past 39 years, since the dam was built, the South Fork and the mainstem McKenzie Rivers, probably as far as Vida, have not been "natural" in terms of historic conditions that fish and humans residents experienced. The river, as now experienced, is not the normal, natural, pristine river. The purpose of the construction project is to return the South Fork and mainstem to more natural conditions. The aquatic organisms that now inhabit the rivers are adapted to pre-modified intake tower conditions. Some changes in aquatic communities that reflect the restored natural conditions can be expected. Aquatic flora will adapt to the more normal conditions, with some species becoming more dominant than others.

<u>Socio/Economic</u>. The 2002 Cougar drawdown had a negative effect on trout fly-fishing on the McKenzie River that was not anticipated or evaluated in the FR/EIS. On April 1, the Corps started drawing down Cougar Reservoir in order to install a multi-level intake tower, which would release water into the river at temperatures appropriate for threatened species of fish. That sent accumulations of clay into the river and turned it a brownish-gray color. This caused turbidity levels to spike more than anticipated. Then, on May 26, the Corps stopped drawing down the reservoir. According to the *Springfield News*, by June 12 the turbidity had dropped back to normal levels.. The *Springfield News* also noted that one of the fishing guides reported staying away from the river from April 14 until June 5. The guide indicated that while the McKenzie was not back to its typical clarity by that time, the fishing was good and the river was getting near record runs of steelhead and salmon.

The turbidity problem affected fishing guides, lodges, motels, gas stations, restaurants, and small grocery stores, according to the Convention and Visitors Association of Lane County (CVALCO). CVALCO, the McKenzie River Chamber of Commerce, and the river guides association mailed out a survey to lodge owners and other local business owners. It was called “Cougar Reservoir Draw-Down Economic Impact Survey” and included questions about type of business, comparative gross revenues from 1999 to 2002 (or, change in gross revenues), customer counts (1999 to 2002), and cancellations or other declines in business attributable to turbidity of the McKenzie River or other Cougar Reservoir draw-down-related factors.

A news release from the McKenzie River Chamber of Commerce and the Convention and Visitors Association of Lane County summarized the results of the survey, as follows. “During March, April and May, area businesses reported 301 cancellations, resulting in lost revenues of $88,656. Most of the losses were reported by river guides, with $15,000 to $16,000 of lost revenue reported by lodging, retail and other business owners. Customer counts dropped by 445, from 1,723. Guide-related revenues were down $48,712 compared to the same time last year. Other survey respondents noted that poor river conditions resulted in a lower call volume with fewer bookings. A total of 27 businesses responded to the survey reflecting only a partial sampling of the overall impacts."

The survey is in no way used as a projection. Neither is it a claim to have captured total area economic losses. As CVALCO noted in their press release, "A total of 27 businesses responded to the survey reflecting only a partial sampling of the overall impacts." In a February 14, 2003, comment letter on the draft Supplemental Information Report, CVALCO also noted that "Reporting was not uniform (some surveys were partially blank). Some responses lacked financial data and indicated only that they were having to abandon their business, or included estimates of lost customers but not related financial impacts. CVALCO was very careful to stipulate in its release of data that results were based on a small response and not representative of total economic losses."

These comments regarding the survey reveal some of the inherent difficulties found in gathering specific information on economic or financial impacts, whether using various survey instruments or direct contacts. Not everyone is willing to provide such information. The survey simply presents a summary of the information provided by the 27 businesses who did respond to the survey.

To help put economic impacts in a local context, some illustrations of claimed losses from a June 7, 2002, letter from the attorney for the President, McKenzie River Guides Association are included here.

"1. Income for some of the resorts is down for the March to May months is down $10,000 to $20,000.

2. McKenzie River Guides Association members have had clients cancel over one hundred fishing days with clients.

3. A Walterville store which usually sells 200 fishing licenses by the end of May, as well as selling associated bait, tackle and other fishing supplies, has only sold about ten licenses to date.

These examples indicate that the recent, prolonged sediment pollution on the mainstem of the McKenzie has led to socio-economic impacts unforeseen in the original EIS or the Supplemental EA."

Locals indicate that these impacts have been difficult, particularly for smaller businesses that are very dependent on the summer tourism season. Some of the businesses operate near capacity for a relatively short season, and don't have the capacity to make up for early losses later in the season. There is local concern that if the same impact recurs over the next few years, there will be more lasting damage to the local tourism economy.

Congressman DeFazio has sponsored legislation for some compensation for losses in the Water Resources Development Act legislation. If that occurs, the incentive of compensation may result in more than 27 respondents submitting claims of economic impact, thereby increasing the $88,656 figure for lost revenues.

<u>EWEB</u>. Eugene Water and Electric Board manages the municipal water supply for Eugene. The intake for the water supply plant withdraws from the McKenzie River near Hayden Bridge, 49

miles downstream from Cougar Dam. EWEB tested for several water quality parameters related to construction at Cougar Project. During the drawdown, turbidity fluctuated between 2 and 26 NTUs. The average turbidity recorded at Hayden Bridge during the 2 month period (April and May 2002) was 10.3 NTUs compared to 2.6 NTUs for the same time period in 2001. Based on treatment plant criteria, additional chlorine was used when the river water exceeded 3.0 NTUs. The additional turbidity needed a slightly higher alum dosage (about 2 mg/l), additional lime for pH adjustment and substantially more backwash water (with corollary return to the river) during the drawdown. Subsequent to the drawdown period, EWEB tested sludge for presence of DDT and found neither DDT nor any breakdown products. EWEB did have concerns that, should turbidity exceed 3.0 NTUs during high demand summer months, they would not have the capacity to do extra filtration to meet that demand. Additional chemical usage and filtration, an increase in power and staffing was required during the Spring. These additional treatments added extra costs to the usual treatment costs. The Corps agreed to hold Blue River Reservoir full and release additional flow late in the summer season to dilute turbidity in the McKenzie. This action was not necessary in 2002.

7. Compliance with Clean Water Act. The ODEQ reviewed both the 1995 EIS and the 1999 EA/Section 404 Evaluations. ODEQ's comments in 1999 were that the potential of the project to produce long-term, identifiable benefits to the fisheries resource through temperature modification appeared to outweigh any short-term effects of turbidity. Should turbidity during construction be visible in the McKenzie River, the reason must be determined and BMPs implemented to solve the problem and minimize the impacts. A log of storm events and river conditions should be maintained and problem events reported to ODEQ. These requirements have been followed by the Corps.

Turbidity refers to water clarity. It is measured in Nephelometric Turbidity Units (NTUs), which indicate how light passes through (or reflects on) suspended sediment in the water column. State standards for turbidity (OAR 340-041-0445(2)(c)) are no more than a 10 percent cumulative increase in natural stream turbidities as measured relative to a control point immediately upstream of the turbidity causing disturbance. However, limited duration activities necessary to accommodate essential dredging, construction or other legitimate activities may be authorized provided all practicable turbidity control techniques have been applied and permit or certification authorized under terms of Section 401 or 404 of the Clean Water Act.

ODEQ is a participating member of the Environmental Coordinating Committee. As such, ODEQ has been advised of all water quality situations that developed during construction of the WTC facilities at Cougar Dam. This coordination will continue during the remaining construction, and post-construction monitoring.

8. Endangered Species Act. The biological assessment previously prepared is being amended to include the Oregon chub, found in 2000 to inhabit the McKenzie River near Springfield. The Corps has made a determination of no effect. The Rush Creek northern spotted owl pair nested in 2003 and fledged two young. No adverse affects on this pair were noted.

9. Evaluation/Mitigation. The situation regarding turbidity and sediment has been evaluated as described above. While turbidity during the 2002 drawdown exceeded predictions in the mainstem McKenzie River, levels were not unusual for historic late winter-early spring flood events. The drawdown did occur later in the Spring than predicted, making turbidity more noticeable and interfering with the trout fly-fishing season. The Corps stopped the drawdown at

1,400 feet elevation, instead of continuing to lower the pool to 1,375 as originally proposed, and the water cleared to less than 15 NTUs by June 15.

This situation can be mitigated during the remaining 2 years of construction by operating the reservoir at 1,450 foot elevation year-round to the extent possible. Levels exceeding 1,450 feet will be drawn down at the rate of 6 feet/day instead of the previous 3 feet/day. This should allow the reservoir to be at 1,450 feet by March 1, and returned to 1,450 feet more quickly if there is a major Spring storm. Turbidity measurements during November through January indicate that the present management of the residual pool is meeting expectations of lower turbidity. Turbidity will continue to be monitored during construction years.

DDT was not detected in sediments below Cougar Reservoir. Monitoring will continue during construction years.

Deposition of fines and insect occurrence were evaluated during the summer/fall of 2002. While accumulation of fine sediment has occurred below Cougar Dam over an unknown time period, the high turbidity events during Spring 2002 were unlikely to have had long-term negative impacts on spawning gravel quality below Cougar Dam. Analysis indicated that the macroinvertebrate community below the dam was degraded in comparison to the community located above the reservoir. However, this is not unusual for areas located below dams, and this trend was also indicated in samples collected during 2000 and 2001 prior to drawdown of Cougar Reservoir

Income losses in 2002 due to reduction of trout fly-fishing and associated expenditures were evaluated by the Convention and Visitors Association of Lane County (CVALCO). Legislative action may provide some mitigation for these losses.

Actions by EWEB due to turbidity in municipal water supply intake have been described. Additional filtering was required during the Spring, but not during Summer months. Water is available from Blue River Reservoir to dilute turbidity in summer months should this become a problem.

10. Significance. Effects of turbidity in the South Fork of the McKenzie and the McKenzie mainstem during construction drawdown of 2002 were primarily local and esthetic. There are no indications that fish or aquatic invertebrates were adversely affected. Fishing later in the season was quite good (Stahlberg, 2002.) Fall spawning in the South Fork noticeably increased in 2002 due to river water approaching pre-dam levels, a strong indicator that the purpose of the temperature control project will be achieved. Total spring chinook redds below Cougar Dam increased from 61 in 2001 to 108 in 2002. This increase occurred below USFS Road 19, about 2.4 miles below the dam; above the bridge there was a decrease in redds from 44 in 2001 to 24 in 2002. This was a good year for spring chinook, thus all of the increase is not necessarily due to the restoration of normal stream temperatures (ODFW, pers. comm. 2003).

There was an unexpected financial impact on the local economy. Interference with spring trout fly-fishing was not anticipated. According to CVALCO, local residents and businesses reported losses totaling about $88,656. While this may have caused temporary hardship for local residents, it is not regionally or nationally significant, given that the 2002 Oregon Employment Department Regional Economic Profile indicates that the Eugene MSA (Lane County) had a 2000 population of 323,950 people, with a per capita income of $25,584, resulting in total income of approximately $8.3 billion dollars in the regional area. Springfield is the nearest city for which the Oregon Employment Department 2002 Regional Economic Profile provides statistics on population. It had a 2000 population of 52,864. (Neither the Oregon Employment Department or the Portland State University Population Research Center provide information on smaller communities such as Walterville, Leaburg, Vida, Blue River, and McKenzie Bridge.) The U.S. Census Bureau, Census 2000, shows 1999 per capita income of $15,616. Using the local Springfield population of 52,864 people, with a 1999 per capita income of $15,616, results in a total income of approximately $825.5 million in the Springfield area. Recognizing that the losses actually reported may not capture the total economic losses that resulted from the Cougar drawdown, even a substantial increase in losses would not be regionally significant, or in the more local context of Springfield. It is recognized that there were unanticipated disruptions to individuals in local communities, and those affected have concerns about economic impacts to their businesses. Recompense is a possibility via legislative action. The local and regional economy also benefited from construction related expenditures, although no estimate of that benefit is available. With changes in operation of Cougar Reservoir during the remaining construction years, interference with trout fly-fishing season and subsequent economic loss is not expected to re-occur or be as pronounced as in 2002. Heavy spring storms, however, could still result in turbid conditions. In fact, a winter storm resulted in high turbidity and flows. By holding the pool at 1,450 feet, turbidity below Cougar was back to 6 NTUs by the March trout season. While low NTUs during the entire fishing season cannot be assured, the Corps has taken and will continue to take all available measures and practices to reduce disruption during the 2 remaining years of construction.

11. Coordination

The draft EA amendment and SIR were issued for 30-day agency and public review on January 30, 2003. Both EA amendment and SIR were made available on the internet. A public notice and draft EA were mailed. Comments were requested from numerous agency and interested organizations and publics, including:

A public meeting was held in Walterville, Oregon, on February 12. In addition to news releases, a reminder of the meeting was sent to interested publics by Congressman Peter DeFazio's office. About 80 people attended the meeting. Comments from the meeting were summarized and responded to in a posting on the Corps' internet site for the project. The Corps received six written comments on the EA/SIR as a result of the meeting, mailing and internet posting. Comments were received from the National Marine Fisheries Service (NMFS), the McKenzie Watershed Council Water Quality Monitoring Committee (MWWQC), Eugene Water and Electric Board (EWEB), William C. Carpenter Jr., Kari Westlund (CVALCO),and David Rodriguez.

The NMFS provided limited, e-mail comments on pre-construction water quality. <u>Comment</u>: The designation of the South Fork McKenzie water as "excellent" is questioned because the recommended maximum for salmonid spawning is 55 degrees F. <u>Response</u>: Temperatures do reach 60 degrees F during summer. However, under current drawdown conditions, the problems regarding reluctance of spawners to enter the South Fork during summer and regarding warmer than normal water temperatures during overwinter incubation have been ameliorated to some degree, if not to a substantial degree. So, water quality has been improved already with respect to these parameters. As noted, the purpose of the WTC project is to restore river temperatures to pre-dam conditions.

The MWWQC acknowledged that many individual Partner organizations within the Council support the WTCP. Comment: The Corps needs more discussion on adaptive management scenarios and "emergencies" like the high water period in January 2003. Response: The Corps will continue to discuss adaptive management in the context of the ECC. The high water period in January did not constitute an emergency. Comment: The Corps should identify and analyze potential measures to decrease turbidity. Response: The reservoir operational plan presented in the Draft SIR contains measures to reduce turbidity downstream of Cougar. The target pool elevation maintained during the non-construction season and increase in rate of evacuation serve to reduce turbid discharge as much as possible. Structural measures inside the reservoir on a practical scale would be ineffective during high inflows. Comment: There is no discussion of the development of the sediment concentration/turbidity coefficient (p. 29 of the draft SIR). Response: Discussion of estimated sediment loads as related to turbidity is presented in Appendix D of the SIR. Comment: There is conflicting information in Section 7.5 about sediment deposition into the river. Response: Section 7.5 has been clarified. While sediment core analysis of both the South Fork and mainstem McKenzie indicated that fine particles were located in the South Fork, some very fine particles remained in suspension for greater distances. Some of these very fine particles probably settled out in the mainstem on the gravel surface, but were not found in the cores; some likely traveled all the way to the ocean. Comment: The following techniques to protect water quality were not addressed: bed/bank scour control on reservoir inflow, such as bank armoring; establishment of vegetation above the 1,450 foot level to counter wave-driven erosion. Response: Bank protection in certain areas would possibly result in more erosion downstream and further degrade water quality. Re-vegetation of the reservoir has occurred above the 1,450 foot level in some areas naturally. Comment: (Appendix A, SIR) Leaburg Lake should be evaluated as a potential sediment sink. Response: It is likely that some sediment deposition has occurred over time in Leaburg Lake. We did not evaluate Leaburg Lake as a sediment trap as part the SIR because our analysis of sediment transport out of Cougar did not indicate that a high degree of sedimentation would have occurred in Leaburg Lake due to construction activities at Cougar. The bulk of the sediment discharge from Cougar was made up of very fine grained material which would require a long residence time to settle out in Leaburg Lake. Sediments within Leaburg Lake would likely be derived from a number of sources, including the mainstem McKenzie and Blue River, as well as the South Fork (Cougar Reservoir). All of the forested areas in the area had DDT applied between 1949 and 1953 for budworm control (ref. U.S. Forest Service Map 31). We felt collecting suspended sediment during storm events would better represent what might be migrating out of Cougar Reservoir. Comment: The type and location of pesticide monitoring is not specified in the SIR, nor is mitigation, other than sediment minimization, proposed. Could the Corps use the technique of using "lower" life forms to assess the tropic accumulation of DDT? Response: DDT does bioaccumulation and the Dredge Material Evaluation Framework has established protocol for conducting bioaccumulation testing. A bioaccumulation "trigger" or level at which bioaccumulation testing should be conducted, has been established at 50 ug/kg. All samples collected within the reservoir were well below the trigger level. No DDT has been detected below the reservoir. Comment: Additional sampling for DDT is strongly encouraged. Response: Additional sampling for DDT has been conducted on suspended sediment (SS) below the reservoir during two storm events. There are plans to continue DDT testing on SS during future storm events. No DDT has been detected below the reservoir. Comment: A more serious consideration of downstream aquatic vegetation is encouraged. Response: See new section on Aquatic Vegetation added to the final documents.

EWEB. EWEB reiterates their overall support for the WTCP. Comment: Consider the events of January 2003. Response: These events have been considered and described in the final SIR/EA amendment. The Corps has maintained the pool at the target elevation of 1,450 since the Rush Creek outlet failed. Comment: Maintain the pool at 1,450'. The larger pool will keep additional sediments under water and provide additional buffering for future turbidity events. Response: Concur. The pool is being maintained at this level until the bank is stabilized, as needed. A permanent change in operation, which would maintain the pool at 1,450 feet for the remainder of the construction period, is an option. If the pool is maintained at this higher elevation the following could occur:

- An increased risk of flooding the construction site by overtopping the cofferdam at 1,495 feet during the construction season (13.7 percent vs. 7.8 percent).
- An increase in the relative time it takes to clear the reservoir of turbid water caused by erosion occurring within the reservoir. The volume of water the reservoir holds at 1,450 feet is approximately three times greater than at 1,400 feet. It would take longer to clear the reservoir of the turbid water, extending the duration of the turbidity downstream.

The effects on erosion and sedimentation processes within the reservoir by operation of the pool at the 1,450 foot level versus 1,400 feet are:

- A likely decrease in slope failures in the lower pool. Several localized slope failures were observed after the late January storm. Changes in pool elevation would be smaller for a 1,450 foot pool given the higher storage capacity above 1,450 feet.
- More of the exposed fine sediment deposits are covered at a 1,450 foot level, thereby exposing less material to resuspension and transport downstream.

Comment: The EPA chronic water quality criteria for DDT is 0.001 ug/l. Response: Corrected. Comment: While it is true that DDT is hydrophobic and has little affinity for water, DDE is more water soluble and more likely to be found in the water column than DDT. Response: It is true that DDE is slightly more soluble than DDT, but is still very low,< 0.1mg/l. Monitoring is planned for total DDT (DDT + DDE + DDD). Solubilities are:

pp' DDT = 0.0077 mg/l @ 20ºC
pp' DDE = 0.065 mg/l @ 24ºC
pp' DDD = 0.05 mg/l @ 25ºC

Comment: EWEB does not provide municipal water for Springfield. Response: Corrected. Comment: The effects on EWEB's operations included additional chemical usage and filtration, an increase in power and staffing requirements, and an increase in costs. Response: Effects have been added. (SIR) Comment: The information is Section 4.6.3 is somewhat misleading. There are no ambient water quality criteria nor is there an MCL for diazinon. The detection of malathion at 0.155 ug/l exceeds the EPA ambient water quality chronic criteria of 0.1 ug/l. EPA freshwater acute chronic standard for DDT is misreported as 0.0001 ug/L. Response: It was not stated that there was a water quality criterion for diazinon. What was stated was that "no contaminants were detected above **established** EPA concern levels ... ." Although malathion was detected at 0.155 ug/L in one sample, none was detected in the duplicate. That was the basis for stating that no chemicals were found above concern levels – including malathion. Wording in Section 4.6.3 has been clarified and the DDT criteria reported correctly. Comment: Section 7.1 Turbidity. Turbidity during April and May 2002 increased EWEB's cost to process water. Response: Increased costs have been acknowledged in the Economics Section and other relevant sections. Comment: Section 7.3. DDE is more soluble than DDT. It is important to continue to look for DDE below the dam. Response: See response above regarding DDE. Comment: Appendix A—additional monitoring for pesticides, especially at Leaburg Lake, is needed.

Response: Sediments within Leaburg Lake would likely be derived from a number of sources, including the mainstem McKenzie and Blue River, as well as, the South Fork (Cougar Reservoir). All of the forested areas in the area had DDT applied between 1949 and 1953 for budworm control (ref. U.S. Forest Service Map 31). We felt collecting suspended sediment during storm events would better represent what might be migrating out of Cougar Reservoir. Comment: Appendix B. Please provide method detection levels of the 1996 sediment sample analysis. Response: Total DDT was detected at 0.0025 mg/kg. Comment: Evaluate and report on the correlation between DDT and TOC levels detected in the August sampling. Response: The data indicate a correlation between total DDT and TOC. This is not too surprising, as the forest was treated with DDT between 1949 and 1953 (U.S. Forest Service Map 31). It appears that this same organic material, that was treated with DDT and became part of the forest floor duff, is still present in organic lavers within the reservoir. Total DDT is hydrophobic and binds with both fine-grained sediment and organic material. Comment: Are there any indications that the recent slides related to the Rush Creek diversion failure occurred in areas tested for DDT? Response: There was a composite sample collected from bottom sediments several hundred feet out from the outfall prior to the diversion failure, which contained 1.08 ug/kg total DDT. Comment: Has the Corps considered conducting settling tests on turbid water released from the dam to collect additional material for DDT analysis? Response: The USGS under contract to the Corps has collected turbid water from two storm events (1st event the end of January and first of February, and 2nd event in March). These samples were filtered and no total DDT was detected at 0.0005 ug/kg in the water and 0.002 ug/kg on filtrate. Additional storm event collections are planned.

McKenzie River Guides Association comments, provided by William D. Carpenter, Jr., attorney at law: Comment: The Corps has violated NEPA by relying on a fundamentally misleading economic analysis. Comment: The Corps has erred in relying on incomplete data to conclude that economic losses from the recreational sector is not significant. Comment: The Corps has erred in determining the "context" of significance by distributing impacts countywide instead of locally. Comment: These errors warrant further evaluation and consideration under NEPA. Response: The Corps does not believe that the economic data are fundamentally misleading. The Federal government uses standard metropolitan statistical areas and counties as the lowest-level of measures of Federally-significant events. This is the standard starting point for any Federal economic analysis. In addition, the local communities supplied additional local data which have been incorporated into the final report. Thus, the final report has both standard county Federal data and locally supplied local economic data. Similarly, the standard for what is economically significant to a Federal program is greater than the commenters would like. The reason is that the Federal Government is generally national in scope, and under the Constitution, local issues are usually left to the states and subordinate state political bodies. The Federal focus, per the Constitution, is on inter-state commerce, not intra-state commerce.

The report acknowledges local financial losses and illustrations are included in the final SIR, Section 8.7. In addition, pending agency legislation, WRDA 2003, includes provisions for economic relief for those relatively few businesses and individuals who were severely impacted by the temporary turbidity problems.

Comment: All economic information presented in last year's letter from the Guides remains accurate and valid. Response: Some illustrations of claimed losses from the June 7, 2002, letter are included in the final SIR, Section 8.7.

Kari Westlund, CEO for CVALCO: Comment: CVALCO's limited survey results should not be misrepresented. The SIR should be revised to clarify this issue. Response: The final SIR reflects this issue.

Donald Rodriguez, resident, provided comments via e-mail: Comment: Has release of clay-silt altered the McKenzie River ecosystem forever? Response: There are no data to indicate that clay-silt has adversely affected the McKenzie River ecosystem. A return to more normal river temperatures is expected to have a long-term, beneficial affect on the ecosystem. That is the purpose of the project. Comment: Why the unusual bright green algae/moss? Why wasn't this addressed in the SIR? Response: Oregon State Fisheries biologist anecdotal observations suggest that plant growth has varied in some years even before this new construction at Cougar began. However, a sudden change in species composition and growth for a period of years would indicate a potential problem.

Assuming there was excess plant growth in the McKenzie River in summer of 2002 and that it was related to water coming from Cougar Reservoir, there could be several possibilities. For instance, excess turbidity could reduce light penetration to the river bottom which in turn could allow plant species with different light requirements an advantage over other plant species. Or, transport of sediment from Cougar Reservoir could have resulted in increased nutrients in the river water which in turn could stimulate excess plant growth on the river bottom. Phosphorus is known to attach to fine-grained sediment and it could stimulate plant growth. We have no data to suggest that phosphorus levels were higher in 2002 versus other years. Organic carbon associated with sediment particle could also serve as a nutrient. The temperature of river water could also impact plant growth - warmer water stimulates growth. But, a comparison of mean daily water temperatures at Vida for 2001 and 2002 during the period April through November, shows very little difference except, perhaps in July. The effect was slight. In July 2002 mean daily temperatures averaged 0.8 degrees C higher than in 2001. Even so, from April through June and from August through mid September water temperatures at Vida were warmer in 2001 than 2002. In short, if there was increased plant growth, a combination of decreased light, increased turbidity, possibly increased nutrients such as phosphorus and organic carbon, and different water temperatures may have increased plant growth in the mainstem McKenzie. Or, the increased plant growth may have been a normal between years variation. Once reservoir construction is over conditions should return to as before except for one environmental variable - temperature. Temperature in the South Fork is expected to return to pre-dam conditions.

A point that needs to be emphasized is that for the past 39 years, since the dam was built, the South Fork and the mainstem McKenzie Rivers, probably as far as Vida, have not been "natural" in terms of historic conditions that fish and humans residents experienced. In other words, the river as now experienced, is not the normal, natural, pristine river. The purpose of the construction project is to return the South Fork and mainstem to more natural conditions. The aquatic organisms that now inhabit the rivers are adapted to current conditions. We can expect changes in aquatic communities that reflect the restored natural conditions. A discussion of aquatic vegetation growth has been added to the final SIR.

Comment: Is there a link between the turbidity and the viral deaths in Leaburg Hatchery? Response: No. There is no direct relationship between levels of turbidity or suspended sediment in the water column and the infection rate of fishes with disease. That is, fine sediment particles suspended in water are not typically vectors of fish diseases. However, suspended sediment can stress fishes. Stressed fishes are more susceptible to infection. Oregon Department of Fish and

Wildlife indicated that the presence of hatchery summer steelhead in the mainstem McKenzie River above Leaburg Dam was the likely source of infection for disease outbreaks occurring in rainbow trout held at Leaburg Hatchery. However, turbidity in the hatchery water supply may have contributed at an unknown level to this problem through stressing of the hatchery fish. Comment: Was there a massive fish kill within Cougar Dam during the initial drawdown? Response: No. No dead fish were found except for a few fish that were stranded in specific locations during reservoir drawdown.

12. I have determined that the proposed action would have no significant impact on the environment and that an environmental impact statement is not required. With this action I am amending the environmental assessment for the Cougar Lake Intake Structure Modifications, Lane County, Oregon.

Date 31 JUL 2003

RICHARD W. HOBERNICHT
Colonel, EN
Commanding

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-----Original Message-----
From: lynne krasnow
[mailto:lynne.krasnow@mercury.akctr.noaa.gov]
Sent: Tuesday, May 13, 2003 3:54 PM
To: Willis Chuck
Subject: Cougar SIR

Ok, it's finally happening, I'm looking at the Cougar SIR in detail so I can include a discussion of effects of the turbidity event in the env. baseline section of the Wmette Project biop. As a result, I might be able to have a comment letter to you in the next few weeks (allowing time for chaos due to FCRPS stuff). I assume you still want our comments for the record. But would they be in time for you to make edits in a "final" version? If not, I won't waste time pointing out that, even though water temps in the South Fork below Cougar "never exceeded 60 degrees F" (p. 6), the recommended maximum for salmonid spawning is 55 degrees F. I don't think it's appropriate to say that water quality in the South Fork below the reservoir is "excellent," at least not from the point of view of chinook spawning and incubation. I thought that the high temps during incubation was one of the main reasons for the WTC project.

Obviously, I haven't gotten very far. So this is a good time to find out how any NOAA Fishery comments would be used.

Thanks.

Lynne

February 21, 2003

District Engineer
U.S. Army Corps of Engineer District, Portland
Attn: CENWP-PM-E
P.O. Box 2946
Portland, OR 97208-2946

The McKenzie Watershed Water Quality Monitoring Committee (MWWQC) appreciates the opportunity to comment on the Draft Environmental Assessment and Draft Supplemental Information Report for the Willamette Temperature Control Project (WTCP) at Cougar Dam, Public Notice CENWP-PM-E-03-01. The McKenzie Watershed Council requested (decision November 2002) that the MWWQC, a subcommittee of the Council, review the SIR and provide comments. Please note that following comments come from the MWWQC and not the Council. The MWWQC is comprised water quality, watershed and environmental technical specialists, hydrologists, and other technical disciplines, and are from many of the Partners organizations that comprise the McKenzie Watershed Council. As you already know, many of the individual Partner organizations support the WTCP.

The MWWQC has a number of comments and clarifications to offer on the SIR and EA. Many of the comments are framed in a series of questions the MWWQC considered in its review. The Committee encourages you to consider the comments in the final documents supporting the planned action.

1. Has the Corps provided a thoughtful range of alternatives to manage the reservoir for the balance of the project? The Committee believes the Corps has provided a sufficient range of alternatives to manage the drawdown for the next several years. It is clear that the Corps is making an effort to minimize turbidity and its impacts. The preferred option (LP2) is explained and supported. However, there is no discussion of adaptive management for 2004, which may benefit from additional information obtained in 2003. For example, the high water period of January 03 is a prime example of how the Corps adaptively managed the reservoir. The Corps need more discussion on adaptive management scenarios and "emergencies" like January 03.

While the Corps outlines potential measures to decrease turbidity in the pool by reducing erosion of exposed sediments, there is no discussion of what activities these might consist of. The Corps should look into identifying areas of high slumpage potential and targeting those areas for re-vegetation or other stabilization measures. These same measures could also be beneficial as fish habitat when the reservoir is full. The Corps analysis may suggest that these measures may not be feasible, but at least they have included them in the evaluation of options to control turbidity and potential releases of DDT.

Overall, the MWWQC supports keeping the reservoir pool near the 1400-1450 ft elevation but not in absence of addressing the above comments.

2. Are there concerns for use of "surrogate" data for suspended sediment analysis? The approach used in the SIR appears adequate to produce "gross estimates" of sediment discharge from Cougar Dam. Given the fine grain size in the Cougar sediment, the sediment transport analysis using the SSC-T relationship from Mehama probably errors on the low side. The Committee is encouraged that the Corps has contracted with the USGS to study the SSC-T relationship in the McKenzie River which will allow for these original estimates to be corrected at a future date. Correlations obtained from North Santiam data are likely not different enough from that of the McKenzie for these purposes. However, there is no discussion of the development of the sediment concentration/turbidity coefficient (pg 29), only that it was "concluded" by the Corps.

Please note that in Section 7.5, there is conflicting information about sediment deposition into the river. One statement suggests most all of the sediment was deposited in the South Fork. Another statement indicates that sediment was suspended and passed downstream.

3. Are the recommendations on pages 38 and 39 adequate to protect water quality? The Committee believes the recommendations cannot insure that there is no risk to water quality in terms of sediment, and turbidity with regard to state standards. However, it is likely that a broad range of commonly employed construction site erosion control measures need to be explored for their feasibility. Costs for these measures would range from modest to significant, but many are tried and true erosion control techniques. The Committee sees no mention of the following techniques:

- Bed/band scour control on reservoir inflow, such a bank armoring
- Establishment vegetation, where feasible, immediately above the 1450' level to counter wave-driven erosion

Overall, the Committee does believe that nearly all measures that are likely to have a meaningful impact in controlling the risk to water quality have been included and are adequate.

It should be noted that in Section 8.7, last paragraph that EWEB supplies municipal water to Eugene – not Springfield.

4. Is the monitoring data, post drawdown 2002, adequate enough to draw the conclusions of "no effect" that the Corps suggest? It does appear that the limited monitoring the Corps implemented post drawdown support the effects predicted in the original EIS. Regardless of the high turbidity, it seems indefensible to not have had more monitoring planned for a project of this scope and magnitude. Because of the paucity data and reactive nature of the monitoring, the Committee believes that the call of no effect from the 2002 drawdown is flawed, but to what magnitude we will likely never know due to the lack of foresight.

The Corps did underestimate, greatly, the impacts to the local economy. The Committee strongly encourages the Corps to continue to work with all affected parties to provide compensation for this situation and what may still to come.

5. Is the water quality monitoring program the Corps recommends in Appendix A sufficient? The Committee encourages the Corps water quality monitoring program to highlight the monitoring results for substances such as: diazinon, malathion, as well as DDT breakdown products of DDD and DDE. Leaburg Lake should be evaluated as a potential sediment sink with evaluation of sediment rates behind Leaburg Dam. In doing this, it may be advantageous to collect sediment cores to look at recent sediment versus historic sediment and relative DDT (and other contaminants) concentrations associated with those sediment layers.

The issue of introducing bioaccumulative pesticides is significant, given the sensitive species in the watershed. The type and location of monitoring is not specified in the SIR, and no mitigation actions, other than sediment minimization are suggested. The Committee is aware of the use of worms and other "lower" life forms to assess the tropic accumulation of DDT. This is commonly done in Asian countries. Maybe this could be a technique using river water downstream of Cougar to assess the level of DDT in the system?

Additional sampling for DDT is strongly encouraged by the Committee. Failure to detect DDT in a sample blank should trigger additional sampling, not just a determination that concentrations are low.

The Committee recommends a more serious consideration of downstream aquatic vegetation, which should be paid more attention in the SIR. The WTCP by its very design and purpose will influence aquatic vegetation density and species composition. The Corps should be able to make some predictions of what type of changes may occur based on the change in the river's temperature regime.

Outside of these comments, the Committee believes the monitoring program, with the added USGS work, is likely adequate.

6. Corps NEPA document contends that the proposed action would have no significant impact on the environment and that an EIS is not required. Still true? The Committee believes that the WTCP still should be an EA. This is because it is tiered to an existing EIS that discussed significant effects. It appears that further impacts in 2003 will be less than those experienced in 2002. The cursory data collected in 2002 appears to indicate that even though there was extended periods of high turbidity and sediment released to the McKenzie River, the actual impacts, according to the Corps, was minimal. It does appear that the Corps is taking necessary steps to reduce the effects to the environment for 2003 and beyond. These steps, in addition to the ones mentioned above as needing improvement, would suggest that an EA is sufficient. The MWWQC strongly encourages the Corps to examine these steps and implement where possible. In absence of implementing these steps, the Corps should develop an Erosion and Sedimentation Control Plan for the project.

This concludes the McKenzie Watershed Water Quality Committee's comments on the draft documents offered for public review through Public Notice CENWP-PM-E-03-01. We appreciate your consideration of our comments and look forward to working with the Corps on the successful completion of this project.

Signed:

Jim Thrailkill on behalf of the MWWQC.

cc: McKenzie Watershed Council Partner Organizations
Alan Henning, USEPA
Bill Perry, ODEQ

Eugene Water & Electric Board

EWEB

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February 18, 2003

Colonel Richard Hobernicht, District Engineer
U.S. Army Corps of Engineers, Portland District
Attn: CENWP-PM-E
P.O. Box 2946
Portland, Oregon 97208-2946

RE: CENWP-PM-E-03-01 (Issue Date: January 30, 2003)
Environmental Assessment and Supplemental Information Report
Willamette Temperature Control Project, Cougar Dam and Reservoir

Dear Colonel Hobernicht:

The Eugene Water & Electric Board (EWEB) appreciates this opportunity to indicate our support for the preferred reservoir management option for the remainder of the construction period at Cougar Reservoir, as identified in the Draft Environmental Assessment and Draft Supplemental Information Report referenced in Public Notice CENWP-PM-E-03-01. EWEB also supports the Corps' decision to contract with the U.S. Geological Survey (USGS) for ongoing evaluation of turbidity, suspended sediment and DDT releases from Cougar Reservoir and the relationship between those parameters. Finally, we would like to reiterate our overall support for the Willamette Temperature Control Project at Cougar Reservoir.

We have a number of comments and clarifications to offer on the draft documents referenced in the public notice. We would like our comments to be considered in the development of final documents supporting the planned action.

As a general comment to be considered in the finalization of all documents, EWEB believes that it is important to recognize the events that occurred at Cougar Reservoir during the rainstorm in late January. It is our understanding that in addition to the loss of the Rush Creek diversion, a number of other slides and soil slumps occurred in the exposed sediments, and a number of the tributaries to the South Fork McKenzie River established new courses through the exposed sediments. It is also our understanding that in response to these events- primarily the loss of the Rush Creek diversion- the Corps has decided to, at least temporarily, maintain the residual pool at an elevation of 1450 to 1460 feet. EWEB supports this decision and recommends that the Corps consider maintaining the residual pool at this elevation for the remainder of the project. The larger pool will keep additional sediments underwater and provide additional buffering for future turbidity events.

We have the following specific comments on the draft documents identified in the public notice:

Draft Amendment For NEPA

1. Section 3, Proposed Action. EWEB supports the proposed action.

2. Page 2, DDT. The EPA chronic water quality criteria for DDT is misreported as 0.0001 ug/L. The chronic water quality criteria for DDT is 0.001 ug/l.

3. Page 3, DDT. While it is true that DDT is hydrophobic and has little affinity for water, DDE is more water soluble and more likely to be found in the water column than DDT.

4. Page 4. There does not appear to be sufficient justification for the statement that "Spring storms could still result in increased turbidity below the dam but the turbidity will be of shorter duration." Consider replacing the word "will" with the word "should" to indicate the uncertainty inherent in the statement.

5. Page 6, EWEB. The Eugene Water and Electric Board provides the municipal water supply for Eugene and several small nearby communities. We do not provide municipal water for the residents of Springfield.

6. Page 8, Section 8. In describing the effects on EWEB's operations, indicate that "additional chemical usage and filtration was required." Power and staffing requirements were also increased, resulting in an overall increase to EWEB in the cost of producing potable water.

Draft Supplemental Information Report

7. Page 9, Section 4.6.3 Drawdown Water Quality-Other Parameters. The information as presented in this section is somewhat misleading. There are no ambient water quality criteria nor is there an MCL for diazinon. Consequently, its detection cannot be compared to established standards. The detection of malathion at 0.155 ug/l exceeds the EPA ambient water quality chronic criteria for malathion of 0.1 ug/l. EPA freshwater acute chronic standard for DDT is again misreported as 0.0001 ug/L. While malathion was detected at a concentration exceeding the EPA level of concern, EWEB agrees that the overall export of contaminants from the reservoir was minimal.

8. Page 10, Section 4.6.4 Summary. As indicated in the preceding comment, the statements made in this section are not accurate. There are no ambient water quality criteria for diazinon, and the detection of malathion at 0.155 ug/l exceeds the EPA ambient water quality chronic criteria for malathion.

9. Page 15, Section 5.2.2 BMPs After Drawdown. EWEB is interested in the details of the BMPs to be considered for implementation during 2003 and would like to be

included in the evaluation of potential BMPs to reduce turbidity coming from the reservoir.

10. Page 19, Section 7.1 Turbidity. The elevated turbidity during April and May 2002 at Hayden Bridge increased EWEB's cost of processing raw water by increasing the amount of chemicals and electricity used to process the water and increasing the filtration demands of the water, which increases staffing requirements. The increase in cost was especially significant as demand increased in late May and early June.

11. Page 20, Section 7.2.2 Suspended Sediment Concentration. EWEB believes that the three monitoring sites were located on tributary streams draining *into* Detroit Reservoir. The word "into" seems to have been left out of the sentence.

12. Page 22, Section 7.3 Sediment Sampling and DDT. While DDT is hydrophobic and has little affinity for water, DDE is more soluble and may be detected in the water column. It is important to continue looking for DDE in water below the dam.

13. Page 31, Section 8.1 Turbidity (Water Quality). See earlier comments on water quality parameters. EWEB believes that the ambient water quality chronic criteria for malathion was exceeded in one sample. Also, the word "oganochlorinated" is misspelled.

14. Page 32, Section 8.1 Turbidity (Water Quality). EWEB believes that it is more appropriate to indicate the inherent uncertainty in the analysis by stating that "Spring storms could still result in increased turbidity below the dam but the turbidity *should* be of shorter duration."

15. Page 35, Section 8.7 EWEB. The Eugene Water and Electric Board (EWEB) provides municipal water for Eugene and several small nearby communities. EWEB does not provide municipal water to the City of Springfield.

16. Page 36, Section 9.1 Evaluation/Mitigation. The increased turbidity in the McKenzie River during the late spring and early summer required EWEB to use additional chemicals and electricity for raw water processing. Additional filtration and more frequent filter backwashing were needed to filter the water. The overall impact to EWEB was primarily the additional cost for water processing.

17. Page 38: Section 10.1 Findings. EWEB had to temporarily increase chemical usage and filtration bed backwashing, which increased water processing costs and staffing requirements.

<u>SIR Appendix A</u>

18. Page A-15. EWEB supports the proposed plan for additional water quality monitoring for DDT. We believe that DDT breakdown products DDE and DDD should also be evaluated, and that the Corps should consider additional monitoring in the South Fork

and mainstem McKenzie for diazinon and malathion. Leaburg Lake should be considered as a potential sediment sink, and sedimentation rates and contaminant levels behind Leaburg Dam should be evaluated. We would also like to encourage the Corps to share the proposed plan with the ECC prior to implementation.

<u>SIR Appendix B</u>

19. Page 3, Previous Studies. Assuming that the 1996 sediment samples were analyzed for DDT, please provide the method detection levels for the analyses.

20. Page 7, Conclusion. Please evaluate and report on the correlation between DDT and TOC levels detected in the August sampling. Can a relative correlation between the two parameters be used to evaluate DDT loading based on observed levels of TOC?

21. Page 8, Conclusions. Are there any indications that the recent slides related to the Rush Creek diversion failure occurred in areas tested for DDT during the 2002 sediment studies?

22. Page 8, Conclusions. Has the Corps considered conducting settling tests on turbid water released from the dam to collect additional material for DDT analysis? This would provide information on the DDT load being released through high turbidity events such as occurred in late January 2003.

This concludes our comments on the draft documents offered for public review through Public Notice CENWP-PM-E-03-01. We appreciate your consideration of our comments, and look forward to working with the Corps of Engineers on the remainder of the Cougar project. Please feel free to contact me at (541) 984-4727 if you have any questions or concerns regarding our comments.

Sincerely,

Michael J. McCann
Environmental Specialist

c: Laurie Power, EWEB
Doug Wise, EWEB
Dick Helgeson, EWEB
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February 27, 2003 Via email, Certified Mail, Return Receipt Requested

Mr. George J. Miller
District Engineer
U.S. Army Corps of Engineer District, Portland
Attn: CENWP-PM-E
P.O. Box 2946
Portland, OR 97208-2946

RE: Need for Further NEPA Analysis in 2002 Draft EA Amendment for the Cougar and Blue River Reservoir Temperature Control Project

Dear Mr. Miller:

I wrote Colonel Butler last June regarding the need to do a Supplemental Information Report (SIR) for the Cougar Temperature Control Project. The Corps has now done that, along with issuing a draft Amendment to the Supplemental Environmental Assessment and FONSI, dated July 15, and November 30, 1999, respectively. The McKenzie River Guides Association presents the following comments regarding deficiencies in the current draft Amendment and SIR.

The Association continues to have major concerns with the effects that the construction of Cougar Reservoir has had on its members, the mainstem environment of the McKenzie River, and the communities on the mainstem. Turbidity concerns in the mainstem, and that pollution's economic fallout to the local community continue to be the Guide's major concern.

It is likely that the Corps has violated the National Environmental Policy Act (NEPA) by relying upon a fundamentally misleading economic analysis. Further, the Corps has erred in relying on incomplete and unsubstantiated data in coming to its conclusions that the economic losses from the recreational sector is not significant. This last error is based on the fact that the Corps both considered too large in economic area (i.e. all of Lane County) in determining whether the economic losses, resulting from the prolonged turbidity excursion, were substantial and the economic loss data relied on was only sporadic responses to questionaires. As is discussed, the Corps erred in determining the "context" of the significance because it erroneously determined for the local nature of the project that the economic hardships should be considered countywide, rather than in just the watershed affected. Lane County is one of the largest western counties in the State. It stretches about 200 miles in length. It was erroneous to attempt to compare the economic losses of the McKenzie recreational interests to those of a countywide economy.

As to the second criticism, even the agency, the Convention & Visitors Association of Lane County, (CVALCO), conducting the economic survey relied on by the Corps was critical of the survey's incompleteness and relayed this limited use caution to the Corps. And thus these errors warrant further evaluation and consideration of the significance of the economic losses from the project under NEPA requirements.

As was discussed last year, the "hard look" doctrine continues to applies to the Corps' further NEPA work. Neighbors of Cuddy Mountain v. U.S. Forest Service, 137 F.3d 1372, 1376 (9th Cir. 1998). To satisfy the requirement that it take a "hard look" at the consequences of its actions, an agency must engage in a "reasoned evaluation of the relevant factors" to ensure that its ultimate decision is truly informed. Greenpeace Action v. Franklin, 14 F.3d 1324, 1332 (9th Cir. 1992). An agency's failure to include and analyze information that is important, significant, or essential renders an EA inadequate. 40 C.F.R. § 1500.1 ("The information must be of high quality.") An agency's failure to use the most up-to-date information and tools available, or the inclusion of erroneous information, undermines the public's confidence in the EIS processand renders
it legally defective. Tribal Village of Akutan v. Hodel, 869 F.2d 1185, 1192 n.1 (9th Cir. 1989). Without accurate, up-to-date information, there is no way for the public or the agency to adequately assess the pros and cons of a proposed action. See California v. Block, 690 F.2d 753, 761 (9th Cir. 1982). Under CEQ regulation 40 C.F.R. Sec. 1508.14 (2000), an EIS must assess and discuss the secondary (socio-economic) effects of the project when effects are interrelated to the physical environmental effects. See Stop H-3 Ass'n v. Dole, 749 F.2d 1442, 1461 (9th Cir. 1984)(noting duty to evaluate socio-economic effects under prior regulation).

These fundamental NEPA principles apply to the economic as well as environmental analyses included in an EIS. See Animal Defense Council v. Hodel, 840 F.2d 1432, 1439 (9th Cir. 1988); Hughes River Watershed Council v. Glickman, 81 F.3d 437, 446 (4th Cir. 1996) ("For an EIS to serve these functions, it is essential that the EIS not be based on misleading economic assumptions."); 40 C.F.R. § 1502.23 (cost-benefit analysis). Agencies are required to ensure the professional integrity of all discussions and analyses in an EIS, including economic analyses. Id. §§ 1502.24, 1508.8 (The "effects" that an EIS must evaluate include economic impacts). Thus, an EIS that relies on misleading economic information or fails to include all relevant costs in its economic analysis violates NEPA, because it cannot fulfill NEPA's purpose of providing decisionmakers and the public with a valid foundation on which to judge proposed projects. See, e.g., ONRC v. Marsh, 832 F.2d 1489, 1499 (9th Cir. 1987).

In Hughes River Watershed Council, for example, the Fourth Circuit found that the Corps of Engineers violated NEPA because its EIS for a proposed dam construction project overstated recreation benefits, a defect which impacted 32% of the project's total economic benefits. 81 F.3d at 447. By overstating the economic benefits of the project, the EIS was unable to serve its function of allowing decision-makers to balance the environmental impacts and economic benefits of the project. Id. at 446-48. Similarly, in Van Abbema v. Fornell, in a challenge to a Corps of Engineers EIS for a coal transloading facility, the Seventh Circuit concluded that the economic analysis relied upon inaccurate data, unexplained assumptions, and outdated reports. 807 F.2d 633, 640-42 (7th Cir. 1986). ("If the Corps bases its conclusions on entirely false premises or information, even when its attention is specifically directed to possible defects in its information, we would have difficulty describing its conclusions as reasoned . . . ."); see also Johnston v. Davis, 698 F.2d 1088, 1094 (10th Cir. 1983) (unqualified use of artificially low discount rate in economic analysis, even though legally required, resulted in misleading EIS that violated NEPA); Sierra Club v. Sigler, 695 F.2d 957, 975-76 (5th Cir. 1983) ("The Corps cannot tip the scales of an EIS by promoting possible benefits while ignoring their costs . . . . There can be no 'hard look' at costs and benefits unless all costs are disclosed.")

I. The Corps Economic Analysis Relying On Known Poor Data and An Inaccurate Assumption Is Not Defensible

The Corps full discussion of the economic impacts from the turbidity excursions in 2002 is only partially accurate. The draft Amendment to the EA states the following about the economic impact of Cougar drawdown:

> The 2002 Cougar drawdown had a negative effect on trout fly-fishing on the McKenzie River that was not anticipated or evaluated in the FR/EIS. On April 1, the Corps started drawing down Cougar Reservoir to install a multi-level intake tower, which would release water into the river at temperatures appropriate for threatened species of fish. That sent accumulations of clay into the river and turned it a brownish-gray color. ...
>
> The turbidity problem affected fishing guides, lodges, motels, gas stations, restaurants, and small grocery stores, according to the Convention and Visitors Association of Lane County (CVALCO). CVALCO , the McKenzie River Chamber of Commerce, and the river guides association mailed out a survey to lodge owners and other local business owners. It was called "Cougar Reservior Draw-Down Economic Impact Survey" and included questions about type of business, comparative gross revenues from 1999 to 2002 (or, change in gross revenues), customer counts (1999 to 2002), and cancellations or other declines in business attributable to turbidity of the McKenzie river or other Cougar Reservoir draw-down-related factors.

Draft Amendment to the EA, page 6; SIR at 35-36.

After summarizing the data, and noting, "[a] total of 27 businesses responded to the survey reflecting only a partial sampling of the overall impacts," id., the draft Amendment states:

> Locals indicate that these impacts have been difficult, particularly for small businesses that are very dependent on the summer tourism season. Some of the businesses operate near capacity for a relatively short season, and don't have the capacity to make up for early losses later in the season. There is local concern if the same impact recurs over the next few years, there will be more lasting damage to the local tourism economy.

Id.

Then, in conclusion, the draft Amendment, after summarizing the CVALCO survey, finds:

> While this may have caused temporary hardship for local residents, it is not regionally or nationally significant, given that the 2002 Oregon Employment Department Regional Economic Profile indicates that the Eugene MSA (Lane County) had a 2000 population of 323,950 people, with a per capita income of $25,584, resulting in total income of approximately $8.3 billion dollars in the regional area. Were these losses an underestimate, even doubled the losses would not be regionally significant.

Id. at 8.

The SIR contains essentially the same information, as it also relies extensively on the CVALCO survey for economic loss information. However, CVALCO staff has stated that they did convey the limitations of its survey to the Corps when it presented the results and did not expect the Corps to rely on such a scant survey. In a February 14, 2003 letter criticizing the Corps reliance on its data and press release, CVALCO states:

> Just 27 survey responses accounted for the losses reported by CVALCO. Those losses occurred during March-May of 2002. Reporting was not uniform (some surveys were partially blank). Some responses lacked financial data and indicated only that they were having to abandon their business, or included estimates of lost customers but not related financial impacts. CVALCO was very careful to stipulate in its release of data that results were based on a small response and not representative of total economic losses. Because the survey was distributed by mail from two different organizations and through the McKenzie River Reflections Newspaper, we don't know the size of the survey distribution or the response rate. Informal feedback indicated that many businesses along the corridor were not familiar with CVALCO and therefore chose not to disclose their financial information.

February 14, 2003 correspondence between CVALCO President and CEO Ms. Westlund and Corps' District Engineer (copy attached).

CVALCO concludes by stating:

> It is important that CVALCO's limited survey results not be misrepresented in your Supplemental Information Report as being indicative of total area economic losses. While we wish the survey had resulted in more comprehensive information, it clearly did not. The SIR should be revised to clarify this issue.

Id.

The creator of the survey has acknowledged serious limitations in its accuracy and representative sampling. Therefore, such information cannot be determined as being an actual measure of the total economic loss which the McKenzie River regional communities suffered. Further, in an attempt to note the deficiency, the Corps states "even doubled," seeming to believe that a factor of two was the correct factor to use. However, the Corps does nothing to explain why a factor of two was the appropriate one to use. The estimated loss could have been five times too low, ten times too low, or even twenty times too low. The Corps has failed to give adequate reasoning why two, rather than twenty, is the appropriate multiplier to obtain the actual economic impact from the limited sample impact.

The Corps must only rely on valid data in making its determinations. It further must present this data in the EA when it attempts to use it. Idaho Sporting Congress v. Thomas, 137 F.3d 1146, 1150 (9th Cir. 1998). Relying on such poor data does not give the public the proper opportunity to comment on the accuracy of the actual effects attempting to be analyzed. Id.

Further, the Corps' economic impact estimate basis, differs from the known impacts that actually occurred and were described when they occurred. This was provided in last years Guides's correspondence. All of the economic information presented in last year's letter remains accurate and valid.

II. The Corps Context Of Location for Evaluating Significance Is Wrong

The Corps found, when evaluating the possible economic impacts countywide that such turbidity economic disturbances "would not be regionally significant." Draft Amendment at 8. "'Significantly' as used in NEPA requires consideration of both context and intensity. 40 C.F.R.§ 1508.27. "Context" in the regulations under "Significantly" is defined as follows:

> This means that the significance of an action must be analyzed in several contexts such as society as a Whole (human, national), the affected region, the affected interests and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend upon the effects in the locale rather than in the world as a whole.. Both short- and long-term effects are relevant.

40 § 1508.27(a).

Here, the Corps defined the "locality" or "locale" as Lane County. If it had used a smaller increment, such as Eastern Lane County or the McKenzie watershed area, the finding of no significance may have changed. Had it changed, the Corps would have needed to do further analysis on its current alternative to insure that the amount of turbidity generated by that revised alternative would not have a significant economic consequence on the McKenzie River communities.

There are two cases where the court determined that the "locale" that the agency had determined was appropriate, was too large. The most important, as it is controlling here, is Anderson v. Evans, 314 F.3d 1006 (9th Cir. 2002). In Anderson environmental and animal rights groups had challenged the Environmental Assessment done by NOAA Fisheries regarding the permitting of whale hunting by the Makah Indian Tribe. On appeal, the court found that the locale of whale population that the agency used to determine the impact for killed whales was too large. It required the agency to only consider the population of whales that actually returned to the Sound where the Makah wished to hunt. It overtuned the agency because the "context" locale was defined as too large a population. After dismissing that it did not matter that the whales may have been a subspecies to the more abundant PCFA whales, the court explained the agency's second defense as:

> The EA describes the PCFA as composed of whales that move from one feeding area to another rather than staying in one locale for all the summer months. That some of the wahles who return, ... to the areas of the proposed hunt also visit other areas of the coast cannot, however, eliminate concern about the local impact. The fact remains that a majority of the fairly small number of whales identified in the Makah Tribe's hunting area have been there in previous years, wherever else they may have journeyed. Whether there will be fewer or no whales in the pertinent local area if the hunt depends not on whether the whales who frequent that area also travel elsewhere, but upon the opposite inquiry: whether the whales who heretofore have not visited the area will do so, thereby replenishing the summer whale population in the area, if some of the returning whales are killed.

Id. at 1020.

The court then discussed the reasoning for the local impacts requirements as follows:

> In short, the record establishes that there are "substantial questions" as to the significance of the effect on the local area. Despite the commendable care with which the EA addresses other questions, the EA simply does not adequately address the highly uncertain impact of the Tribe's whaling on the local whale population and the local ecosystem. This major analytical lapse is, we conclude, as sufficient basis for holding that the EA cannot survive the level of scrutiny in this case.
>
> And because the EA simply does not adequately address the local impact of the Tribe's hunt, an EIS is required.

Id. at 1021 (emphasis added).

The second case regarded the Army Corps of Engineers building a port on a Sears Island in Maine. Sierra Club v. Marsh, 769 F.2d 868 (1st Cir. 1984). The court reviewed the broad nature that the Corps had attempted to distribute the economic gains and overlooked the economic harm that would take place on the local island itself. The court discussed this error by stating:

> Fourth, the Corps dismiss the impact on 'upland habitat' as insignificant on the gorunt that there is adequate habitat elsewhere in the area. The force of this argument depends on the meaning of the ward "area." If the Corps means "elsewhere on Sears Island, " its conclusion is weak. The EA's indicate that 'full development' of the southern half of the island will increase the amount of upland habitat 'taken' from 4 percent ... to 23 percent. Since this latter figure is based on a calculation that counts as 'taken' only the land which is actually cleared for construction of buildings and parking lots, the percentage of 'upland habitat' that the development will render unsuitable for wildlife would likely be far higher. If the Corps means to include in the relevant "area" other land on the coast of Maine, it conclusion is more reasonable. Yet we doubt that the Corps can include so wide an area in its calculation. The CEQ's regulations stat that "in the case of a site-specific action, significance [of environmental effects] would usually depend upon the effects on the locale rather than in the world as a whole." 40 C.F.R. 1508.27(a) (1984). Here, the nature of

> the action, and the geographical character of Sears Island, suggest that the appropriate "locale" is Sears Island and its immediate surroundings.

Id. at 881 (noting that evaluation of effects does not warrant a FONSI finding and an EIS is required).

Here, both like the local island habitat and the local whale population, the local impacted economic locale is communities along the McKenzie River. The Corps' economic determination that Lane County is the "locale" is wrong and unsupportable. Like areas along the coast of Maine were too large or the whale population that did not specifically migrate to the hunting area, the area of the full economy of Lane County is too broad an "locale" to be judging the significance of the economic impacts over.

Because of these flaws, the Draft EA and the SIR are unable to fulfill their chief mission, which is to give decision-makers and the public an opportunity to evaluate the pros and cons of the proposed action. Animal Defense Council, 840 F.2d at 1439. If any turbidity excursions begin of the nature of those last year, the EA will have insufficiently reviewed the local impacts of them and the Corps must do a Supplemental Environmental Impact Statement to address the local economic impacts to the McKenzie River communities and businesses from turbidity excursions. Alaska Wilderness Rec. and Tourism Assn. v. Morrison, 67 F.3d 723, 729 (9th Cir. 1995).

Thank you for your consideration of this information. Please respond to me with your decision whether the Corps will further evaluate the economic impacts on local communities to determine whether the economic and socioeconomic impacts are significant with realistic and accurate estimates. This needs to be undertaken unless the Corps can assure the public and my client that the turbidity impacts that occurred last year will not recur.

Sincerely,

William C Carpenter Jr

William C. Carpenter Jr.
Attorney at Law

cc: Aaron Helfrich, President, McKenzie River Guides Association

February 14, 2003

District Engineer
U.S. Army Corps of Engineer District, Portland
Attn: CENWP-PM-E
P.O. Box 2946
Portland, OR 97208-2946

Re: Supplemental Information Report, Willamette Temperature Control Project, Cougar Reservoir, Lane County

Page 37 of the Supplemental Information Report indicates that the Convention & Visitors Association of Lane County Oregon, CVALCO, "...reported losses totaling about $88,656." The Report then compares this to total estimated population and earnings for the Eugene MSA, and indicates that if the CVALCO estimate were an underestimate, even doubling it would not be significant.

Just 27 survey responses accounted for the losses reported by CVALCO. Those losses occurred during March-May of 2002. Reporting was not uniform (some surveys were partially blank). Some responses lacked financial data and indicated only that they were having to abandon their business, or included estimates of lost customers but not related financial impacts. CVALCO was very careful to stipulate in its release of data that results were based on a small response and not representative of total economic losses. Because the survey was distributed by mail from two different organizations and through the McKenzie River Reflections Newspaper, we don't know the size of the survey distribution or the response rate. Informal feedback indicated that many businesses along the corridor were not familiar with CVALCO and therefore chose not to disclose their financial information.

Economic impacts from the Willamette Temperature Control Project at Cougar Reservoir extend far beyond the scope of high turbidity levels caused by the draw down last spring. The loss of the Reservoir itself from recreational use for several years, the obvious impact from the turbidity itself and the related negative media exposure, and the multi-year scope of the project leading to perceptions about river-related experiences being of diminished quality over several seasons have all hurt area businesses over an extended period of time.

It is important that CVALCO's limited survey results not be misrepresented in your Supplemental Information Report as being indicative of total area economic losses. While we wish the survey had resulted in more comprehensive information, it clearly did not. The SIR should be revised to clarify this issue.

Sincerely,

Kari Westlund
President & CEO

cc: Congressman Peter DeFazio
McKenzie River Reflections

Hamilton, Lynne D NWP

From: Miller, George J NWP
Sent: Friday, February 14, 2003 7:33 AM
To: Hamilton, Lynne D NWP
Subject: FW: Cougar Dam Project Folly

Comments on SIR for your action.

GEORGE MILLER
Project Manager
Planning, Programs, and Project
Management Division

-----Original Message-----
From: David R. [mailto:daverio@pacinfo.com]
Sent: Tuesday, February 11, 2003 4:11 PM
To: Miller, George J; Heidi.Y.Helwig@nwp01.usace.army.mi; Willis, Chuck
Cc: travis@willamette-riverkeeper.org; news@springfieldnews.com; mailto:Lowell.Watkins@state.or.us; mailto:michael.b.lambert@state.or.us; mailto:Mary.L.Hanson@state.or.us; mailto:Jeffrey.S.Ziller@state.or.us; info@ortrout.org; Badgley_Anne@fws.gov; mailto:conservation@mckenzieflyfishers.org; mailto:info@mckenzieflyfishers.org; donald.mcisaac@noaa.gov; kit.dahl@noaa.gov; Peter Sorenson; Dan Opalski; Bill Dwyer; Anna Morrison; Cindy Wheeldryer; Bobby Green; Peter DeFazio; Mary Gautreaux; Matt Cooper; jwilson; mstahlberg; Paul Engelking; Simon Guiterrez; Doug Heiken; KLCC; KVAL; news; news; Statesman Journal; KGW Portland; RivRef; Bob Wernick; Tim Hermach; dennis@suncountrytours.com; juine_chada@wyden.senate.gov; mailto:environment@news.oregonian.com; mailto:theresebottomly@news.oregonian.com; news@springfieldnews.com; dave-downing@or.nacdnet.org; Bob Cooper; Bob Gaurd; Peter Petricelli; ott@cdsnet.net; mhanten@morrisonslodge.com; dennis@suncountrytours.com; goodfshn@uswest.net; raft2fish@aol.com; cnjlodge@ptinet.net; pjdonovan@aol.com; info@gorafting.com; irv@roguefishing.com; raft@riveradventure.com; mathers@bendnet.com; sgsfish@aol.com; fishroe@cdsnet.net; ogpa@ogpa.org; Doug Quirk; Marnie.L.Allbriten@state.or.us; Brady.D.Callahan@state.or.us; Kendra.G.Callahan@state.or.us; Sue.M.Engwall@state.or.us; Christine.Mallette@state.or.us; David.C.MCALLISTER@state.or.us; Sally.Vachter@state.or.us; mailto:tom@efn.org; mailto:dburwell@ci.springfield.or.us; mailto:gal@efn.org; mailto:aolander@hmtt.com; mailto:lpeters1024@juno.com; mailto:Gary.E.Rayor@ci.eugene.or.us; mailto:erice@or.blm.gov; mailto:fsimmons@ci.springfield.or.us; mailto:pstcon@aol.com; mailto:thrail@fsl.orst.edu; mailto:PBartel46@aol.com; mailto:Mark.G.Wade@state.or.us; mailto:runyon@proaxis.com; mailto:jpallen@fs.fed.us; mailto:dandy@hopf.uoregon.edu; mailto:barb.blackmore@weyerhaeuser.com; mailto:ryland@mckenzieriver.org; mailto:bumstead@pacificu.edu; mailto:dougb@hsaeug.com; mailto:wade.l.stampe@usace.army.mil; mailto:patg@pacinfo.com; mailto:jeffrey.s.ziller@state.or.us; mailto:kfersch@callatg.com; mailto:%20mwstaff@callatg.com; kathie.eastman@mail.house.gov; editor@eugeneweekly.com; sgutierr@cmc.net; dtodd@darkwing.uoregon.edu; dmonk@oregontoxics.org; Lowell.Watkins@state.or.us; michael.b.lambert@state.or.us; Mary.L.Hanson@state.or.us; Badgley_Anne@fws.gov; donald.mcisaac@noaa.gov; kit.dahl@noaa.gov; mailto:Gary.E.Rayor@ci.eugene.or.us; mailto:dburwell@ci.springfield.or.us; mailto:tom@efn.org; Mcdowell, Jeffrey R; Phillips, William J; mailto:aaron@helfrich.com; mailto:robi8753@aol.com; mailto:cavefam@pond.net; mailto:loubentsen@yahoo.com; mailto:raft2fish@aol.com; mailto:rgsbryant@aol.com; mailto:dburwell@ci.springfield.or.us; mailto:stone51490@aol.com; mailto:digger@clipper.net; mailto:buglemin@iglide.net; mailto:pamjharris@aol.com; mailto:helfrichriver@attbi.com; mailto:helfrich@efn.org; mailto:fishor9446@aol.com; mailto:ken@helfrichoutfitter.com; mailto:tonyhelfrich@attbi.com; mailto:bobh@mckenzieriverfishing.com; mailto:justusoutfitters@aol.com; mailto:laingcom1@aol.com; mailto:pmgs99@aol.com; mailto:mckenzie2o@webtv.com; mailto:spruitt@oip.net; mailto:grob420@aol.com; mailto:sgsfish@aol.com; mailto:steele@proaxis.com; mailto:donwouda@cyberis.net; Ryland@mckenzieriver.org; David Raymond; mailto:jthrail@callatg.com; mailto:morrisette.sen@state.or.us; mailto:corcoran.sen@state.or.us; mailto:beyer.rep@state.or.us; mailto:hayden.rep@state.or.us; mailto:king.rep@state.or.us; mailto:walker.rep@state.or.us; tlonline@earthlink.net
Subject: Re: Cougar Dam Project Folly

To: George Miller
WTC Project Manager

Dear Mr. Miller, February 11, 2003

I received a copy of the WTC - 'Environmental Assessment' as well as the 'SIR' downloaded from your web-site. I continue to see big problems in how various concerns are being addressed. While everyone can appreciate an easing of economic impacts from the project, this should not quietly mitigate the more important environmental concerns that have yet to be adequately addressed. How can the COE possibly know that these 'years' of clay silt releases lasting 1-3 months won't forever alter the river ecosystem? We already saw the changes in the river within the first Fall, months after the turbidity ceased. While you might improve the economic impacts for the short-term with earlier draw-downs, what good will this be if in 5 years we find it too late because the river ecosystem was forever altered?

While I previously raised issue about new underwater vegetation, which turned out to be 'Water Buttercup' (AKA Hornwort) that seems to be slowly taking hold along certain stretches of the McKenzie, I must raise concern about another related matter. Why the unusual bright green algae/moss we experienced in most of the McKenzie River? I think the answer is simple, it was able to take hold along the bottom because of the deposit of clay silt that coated the rocky bottom. The problem is, this clay 'adheres' to rocks & crevices. In all likelihood, this upcoming Summer's moss will be earlier and worse than last Summer. I fear this cycle may continue and increase exponentially as more vegetation establishes itself. WHY WASN'T THIS BRIGHT GREEN MOSS ADDRESSED IN THE 'SIR'?

Maybe what is needed is a glimpse into the future of what the bottom of the pristine McKenzie River may look like should this continued turbidity bombard the river for the next several years. Take a look at the South Fork Santiam River below Foster Reservoir. I don't think we want a river bottom clogged with slimy moss and other vegetation. Oh and by chance, isn't that also the harmless 'Water Buttercup' (AKA Hornwort) that takes everyone's fishing gear in the South Santiam? CAN YOU PROMISE US THAT IT'S NOT GOING TO HAPPEN HERE?

Don't let this become a situation where another COE project has screwed up a beautiful river because of alleged good intentions. You analyze all the details but tend to overlook the big picture. I fear this big COE project is falling into the same scenario. Problems at McKenzie River hatcheries will probably continue to worsen each year as well. Isn't there a link between the turbidity and the viral deaths in the Leaburg Hatchery?

Finally, I appreciated speaking with your Fisheries Biologist Mr. Willis, last Fall, but one very disturbing issue remains that has not been answered. ***Was there a massive fish kill within Cougar Dam during the initial draw-down?*** Right now the numbers do not correspond and I never received a reply to this. I'd like to know just what those fish count numbers really were within the residual pool during draw-down as compared to pre-project. The fact that there was a 57/1 decrease in the volume of water should show an equal increase in fish in the residual pool if there was no loss. If not, and there was a massive fish kill within the dam, then this simply needs to go on record instead of being omitted from the record. I saw dead fish rolling past during these turbidity events last year. I'm surprised there was no mention of such fish mortality within the SIR. Anyway, I have provided the highlights of my discussion with Mr. Willis below because I believe it is important that others better understand this issue which was not addressed within the SIR to any degree of reliability.

Sincerely,

David Rodriguez
87984 Heather Drive
Springfield, Oregon 97478
(541) 747-5093

2/18/03